

AN OUTLINE
OF
MEDICAL CHEMISTRY,
FOR THE
USE OF STUDENTS.

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P R E F A C E.

THE object of this little work is expressed by its title,—an *Outline* of Medical Chemistry, which outline is to be filled up by aid of text-books or of lectures.

While, then, it is directive in its character, it has been thought useful to insert such facts as are of the most importance, in such a form as to be of easy reference for review.

The science of Chemistry has grown to be one of such extent and intricacy, that its study demands the undivided attention of those who would be thorough Chemists.

To expect this of the Medical Student, or Physician, whose attention is necessarily diverted by other important pursuits, is unreasonable. These may readily gain the *essentials* of the science; the accomplishments must be attained at leisure, in the study or the laboratory.

The *essentials* of the science (to medical men) are its *principles*, the laws of affinity, combination, &c., with so much of its detail as relates to Pharmacy, Toxicology and Physiological Chemistry. Quantitative analyses are seldom undertaken by the practising physician, and the application of Chemistry to the arts generally is, although manifestly desirable, by no means essential. The attempt to grasp too much often results in failure to comprehend even a little.

It is believed, that if the study of Chemistry be confined by

the student to the limits thus laid down, its acquisition will be easy, and the knowledge obtained permanent.

The department of Organic Chemistry is especially so encumbered and so unsettled, that a *very* general survey of it has been taken.

The subject of Physiological Chemistry, belonging more properly to works in that branch, has been merely touched upon.

The formulæ for the chemical preparations of the U. S. Pharmacopœia have been written in prescription style, as a useful exercise to the student, as well as for compactness; the directions are in English. The symbols have generally been employed, in preference to naming the element or compound, for the same reasons.

The nature and limits of the work have not permitted reference to disputed points, nor, generally, to authorities. Much aid has been obtained from the invaluable U. S. Dispensatory of Wood and Bache, and in the department of Organic Chemistry, both as relates to the arrangement and the facts, from Dr. Bridges' edition of Fownes' Chemistry.

A Glossary has been added, containing such terms and synonyms as would be most perplexing to the beginner.

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ERRATA.

Page 45, line 15. Before "metals," insert, "certain."

" 57, last line. For "Iron Pyrites, Bisulphide of Iron," read, "Green Vitriol, Sulphate of Iron."

" 100, line 21. For "40°," read, "—40°."

" 156, line 13. For "subacetatis," read "subacetas."

MEDICAL CHEMISTRY.

PART I.

PRINCIPLES OF CHEMISTRY.

DEFINITION. Chemistry is the science which investigates the reaction between the particles of matter.

REACTION is mutual action. It may be: 1. *Attraction*; 2. *Repulsion*. It may take place : 1. Between *masses*; Ex.: Gravity. 2. Between *masses and particles*; Ex.: Sound. 3. Between *particles*; Ex.: Cohesion, adhesion, and chemical affinity.

I. ATTRACTION.

May take place (A) between like particles: *Cohesion*. (B) Between unlike particles: (a) *Adhesion*; (b) *Chemical affinity*.

A. BETWEEN LIKE PARTICLES.

A. COHESION.

Attraction of aggregation holds particles together, forming masses. Its variations give softness, hardness, tenacity, brittleness, &c. It is overcome by mechanical force

and by heat. The particles of solids cohere most strongly, liquids less, and in gases the force is not apparent. When the particles of a solid are arranged in a distinct geometrical form, it is called a crystal. Crystals are arranged in classes, according to the relative length of their axes and the angles formed by the planes of those axes. Crystals may be obtained: 1. By deposition from a concentrated solution. 2. By sublimation. 3. By fusion and slow cooling. 4. By the introduction of foreign bodies into the solution. Crystalline form often serves to distinguish bodies. Bodies possessing the same crystalline form, are said to be *isomorphous*. Crystallization is employed to separate substances of different solubility from the same solution, the least soluble crystallizing first.

B. BETWEEN UNLIKE PARTICLES.

A. ADHESION.

Adhesion may take place

1. Between solids: Friction, cements.
2. Between solids and liquids: wetting, capillary attraction. *Solution* is partly chemical in its nature. The point at which a liquid ceases to take up any more of a solid is called its point of saturation. A liquid saturated with one solid may dissolve another. Heat generally increases solubility, but in some instances does not affect it, or diminishes it.

3. Between solids and gases. Certain solids, as charcoal, will absorb many times their bulk of certain gases, and give them out upon the application of heat.

4. Between liquids—Diffusion. Endosmose and exosmose. Solution. As a general rule one liquid is indefinitely soluble in another.

5. Between liquids and gases. Many liquids dissolve large quantities of gases, which they give out upon heating; Ex.: Solution of Ammonia.

6. Between gases—Diffusion. Two gases tend to mingle, no matter what their density. The law is, that the *diffusion volume*, that is, the tendency of gases to interchange particles, is inversely as the square root of their density. When gases are suffered to diffuse through membranes, this law does not hold good, but those gases most easily liquefied are found to pass most readily.

B. CHEMICAL AFFINITY.

Chemical affinity causes the combination of bodies to produce compounds differing in properties from their constituents.

Combination differs from *mixture*: 1. In a mixture, the properties of the components may be recognized; in combination, not. 2. The components of a mixture may be separated by mechanical means; in combination, only by chemical means. 3. Substances may be mixed in any proportion; they combine only in certain definite propor-

tions. Chemical combinations cause change : 1, in volume ; 2, in state ; 3, in color ; 4, in general properties.

Affinity and *contact* are necessities for combination. It is opposed by *cohesion*; favoured by, 1, pulverization, and 2, solution or liquefaction, which act by overcoming cohesion and favouring contact; 3, by heat; 4, by light; 5, by electric spark; 6, by *catalysis* or *presence*; 7, by the constituents being in the *nascent state*.

LAWS OF COMBINATION. 1. All chemical compounds are definite in their nature, the ratio of their elements being constant. The numbers expressing the relative quantities in which elements or compounds combine, are termed their *equivalents*, or combining weights; and when the proportions are estimated by volume, the combining volume.

2. When combination does not occur in the lowest combining proportion of the constituents, it takes place in a *multiple* of that proportion.

3. The equivalent of a compound is the sum of the equivalents of its constituents.

Substances containing the same elements in the same proportion, and possessing different properties, are said to be *isomeric*.

When they contain the same elements in the same *relative* proportion, with different properties, they are said to be *polymeric*.

The union of *two* elements is termed a *binary* compound.
Ex. : Potassa, KO.

The union of two *binary* compounds gives a *ternary* (Ex.: KO₂SO₃); and of two *ternary*, a quaternary compound. (Ex.: AL₂O₃+KO₂SO₃.)

Symbols are used to represent elements: the initial letter of the Latin name is usually employed. When two elements have the same initial, they are distinguished by a second, smaller letter. (Ex.: P, Phosphorus; Pb, Lead; Pt, Platinum.) The symbol represents *one equivalent* of an element; a number affixed is the coefficient. (Ex.: Fe, one equiv. iron; Fe₂, two equiv.) In compounds, the electro-negative element or compound is written last, and gives the generic name, while the electro-positive determines the specific title. A number placed before a binary compound is its coefficient. (Ex.: 2 Fe₂O₃, 2 equiv. of the sesquioxide of iron.) When intended to effect a ternary or quaternary compound, the whole is included in a parenthesis, and the number prefixed. (Ex.: 2 (KO₂SO₃), two eq. sulphate of potassa.) When two binary compounds unite, a comma is placed between them. Two ternary compounds are united by the sign plus (+). Organic acids are frequently represented by their initial, having over it a dash (Acetic acid, A.)

NOMENCLATURE. The name of a chemical compound expresses its composition. *Binary* compounds generally terminate in *ide* (oxide, hydride, sulphide, &c.), except when *acids*. Acids terminate in *ous* or *ic*, the latter signi-

fying a higher degree of oxidation than the former. (SO_2 , sulphurous acid; SO_3 , sulphuric acid.)

A binary compound, containing one equivalent of each of its constituents, is distinguished by the prefix *proto* (MnO , protoxide of manganese; FeS , protosulphide of iron). When in the proportion of one to one and a half, or two to three, *sesqui* (Mn_2O_3 , sesquioxide of manganese). When one to two, *bi* or *bin*, and three *ter* (MnO_2 , binoxide of manganese; SbS_3 , tersulphide of antimony). When less than one of the electro-negative element is present, the prefix *sub* is used, more accurately *di* (Cu_2O , sub or dioxide of copper). *Ternary* compounds of an acid, ending in *ous*, terminate in *ite*; of an acid in *ic*, in *ate*. (Sulphurous acid, sulphite; sulphuric, sulphate.) The prefix *hypo*, means less (oxygen) than; *hyper* or *per*, more than; (ClO_4 , hypochloric acid; ClO_5 , chloric acid; ClO_7 , hyper, or perchloric acid). These prefixes remain when the acid is combined (KO_2ClO_7 , perchlorate of potassa). The prefixes *sub* (di or tris), *mono*, *sesqui*, *bi*, *ter*, *quad*, express the relative quantities of acid and base ($3 \text{PbO} \overline{\text{A}}$, *sub* (tris) acetate of lead; KO_2SO_3 , monosulphate of potassa; $\text{KO}_2\text{Cr}_2\text{O}_7$, bichromate of potassa, &c.).

C. DECOMPOSITION

Is the separation of the elements of a compound. The elements may, 1. Be separated and remain so, or enter

into new combinations among themselves,—*Decomposition proper*. 2. They may be separated by the agency of a chemical substance which combines with one or more of them,—*Decomposition by superior affinity*.

a. *Decomposition proper*, takes place in most organic substances upon the cessation of vitality ; a certain degree of temperature, moisture, and the access of air, are necessary. It may also take place spontaneously in inorganic substances, and is aided by

1. *Light*. Example : Decomposition of iodide of silver in the daguerreotype.

2. *Heat*. Ex.: Decomposition of carbonate of lime.

3. *Electricity*. Voltaic decomposition.

4. *Catalysis*. Ex. : The decomposition of chlorate of potassa favoured by the presence of sand.

5. *Example*. Fermentation.

b. *Decomposition by superior affinity*. 1, single elective affinity ; 2, double elective affinity.

1. Single elective affinity, is where a substance is presented to a compound for which one of the constituents of the compound has a greater affinity than it has for the other constituents of the compound. Ex. : Water (HO) and potassium (K) become potassa (KO) and hydrogen (H), which is liberated. Carbonate of potassa and sulphuric acid become sulphate of potassa and carbonic acid, which is liberated. (KO, CO_2 and $SO_3 = KO, SO_3$ and CO_2)

2. Double elective affinity, is where two substances are

presented to each other, the constituents of which from superior affinity, on one side or both, mutually interchange. Thus, sulphate of potassa and nitrate of baryta become sulphate of baryta and nitrate of potassa (KO_3SO_4 and $BaO_3NO_5 = BaO_3SO_4$ and KO_3NO_5). Decomposition by superior affinity is influenced by the same agents as decomposition proper; also by

1. *Insolubility.* Where the compound of any two of the constituents of two given soluble substances is insoluble, that compound will generally be formed upon mixing them. It is in this fact that most of the chemical tests are founded.

2. *Volatility* promotes decomposition. If the result of the combination of any of the constituents of two substances is volatile, decomposition readily takes place upon mixing them.

3. *Elasticity, &c.* Pressure retards the evolution of gas. Carbonate of lime heated, with access of air, is decomposed, with the evolution of carbonic acid; heated in a close vessel, it is fused, without decomposition. Steam passed over heated iron is decomposed, oxide of iron being formed and hydrogen evolved; hydrogen passed over oxide of iron forms water, by combining with the oxygen, and the iron is reduced.

D. SPECIFIC GRAVITY.

The relative weights of bodies are expressed by com-

paring them with a fixed, assumed standard. This standard is, for solids and liquids, *water*; for gases, *air*.

The specific gravity of a solid is determined on the principle that a body immersed in a liquid, displaces a volume equal to its own. Hence by a known hydrostatic law the immersed body loses weight equal to that of an equal bulk of the liquid. In practice, a solid is first weighed in air, and then in water, and the loss noted. The weight in air divided by the loss of weight in water gives the specific gravity.

The specific gravity of liquids is determined : 1. By filling a counterpoised bottle, capable of containing a known weight of water, with the liquid, and comparing the weight with that of the known weight of water.

2. By the *hydrometer*, a graduated rod, with a bulb, so adjusted as to float with a mark, or zero, at the surface, in water; of course, above, in heavier liquids, and below, in lighter.

3. By weighing a solid in water, and noting its loss of weight, then in the liquid to be examined; the latter divided by the former gives the specific gravity of the liquid.

The specific gravity of gases is determined by admitting the gas into an exhausted counterpoised globe, capable of containing a known weight of air, and comparing the two.

E. ELECTRICAL AND MAGNETIC ATTRACTION. See ELECTRICITY and MAGNETISM.

II. REPULSION.

A. LIGHT.

Is very little connected with elementary chemistry.

THEORIES. Newton's, of Emission ; Huygen's, or Undulatory. The latter is generally adopted, but the language of the former is used from habit and convenience.

Light proceeds from luminous bodies with great velocity—about 200,000 miles per second—in diverging rays, and its intensity is inversely as the square of the distance. When a ray of light falls upon a surface, it may be : *a*, reflected ; *b*, transmitted ; *c*, absorbed ; or partly reflected, absorbed, or transmitted.

a. Reflection. The angle of reflection is equal to the angle of incidence. If the reflector be a plane surface, the rays are reflected in nearly parallel lines ; if concave, they are converged ; if convex, diverged.

b. Transmission. Substances which transmit light are said to be transparent or diaphanous. If the ray fall perpendicularly, its direction is not altered. If obliquely, it is refracted in passing from a rarer to a denser medium towards the perpendicular, and *vice versa*. The amount of refraction depends upon the angle of incidence and the nature of the medium. Media whose surfaces are not parallel, permanently alter the direction of the ray. (*Prisms, lenses.*) Ordinary light is compound, and may be decomposed by refraction, or reflection. Colour de-

pends upon the (*c*) *absorption* of certain portions of a beam of light and reflection of others. Certain of these coloured rays possess chemical powers (*Actinism*), causing combination (Ex.: chlorine and hydrogen), or decomposition (Ex.: iodide of silver). The art of Photography depends upon the decomposing power of light. Light may be *polarized* by passing it through certain *double refracting* media, and by reflection. Polarized light will no longer pass through substances transparent to common light. It is influenced by a current of electricity.

B. HEAT.

a. SOURCES. 1, Solar; 2, Chemical; 3, Mechanical.

b. COMMUNICATION. 1, Radiation; 2, Conduction; 3, Convection.

1. *Radiation.* The rays pass with great velocity, in straight lines, in every direction from the heated body. Their intensity is inversely as the square of the distance from it. Do not warm gases. Radiation is affected—1, By temperature, being more rapid at high temperatures; 2, By the nature of the surface. Colour does not affect it, unless the heat be accompanied by light. Radiant heat falling upon a surface is: 1, transmitted; 2, absorbed; 3, reflected. Substances which transmit heat are said to be transhalent or diathermous. There is no direct connection between transhalency and translucency. Surfaces which radiate freely absorb freely, and *vice versa*. Colour influences

absorption of heat accompanied by light. Reflection is inversely as absorption and radiation, and follows the laws of light. Heat may be refracted and polarized.

2. *Conduction.* Heat passes slowly from particle to particle of the conducting body. Solids are the best conductors, and the metals the best of the solids. The conducting power of liquids and gases is so slight, as to be inappreciable in ordinary experiments.

3. *Convection*, or the circulatory process, is that by which gases and liquids are heated. Heat is applied below, the lowest particles become heated, therefore specifically lighter, rise, and their place is supplied by colder ones from above. A liquid boils when the tension of its vapour is sufficient to overcome the cohesion of its particles and the pressure upon its surface. Hence the boiling-point depends : 1, upon the liquid ; 2, upon the pressure. *Vaporization*, is the conversion of a liquid into vapour by boiling. *Evaporation*, takes place from the surface, and at temperatures below the boiling-point.

c. CAPACITY FOR HEAT. Different bodies exposed to the same source of heat for an equal time, will have different temperatures ; the body which requires the greater heat to elevate its temperature to the same degree, is said to have the greater *capacity*. *Specific heat*, is the amount required to raise an equal weight of a substance through one degree of the thermometer, as compared with a standard,—*water*, in the case of solids and liquids, and

air in that of gases. By increasing the capacity of a body for heat, heat is absorbed and temperature lowered, and *vice versa*. When *equivalent* weights of bodies are submitted to experiment, the specific heats are found to be nearly identical, or in a simple mathematical ratio.

d. LATENT HEAT. Liquids have a greater capacity for heat than equal weights of the solids from which they are formed; and gases than liquids. Hence during the conversion of the solid into a liquid, and liquid into gas, heat is absorbed, is no longer sensible to the thermometer, and is said to be latent. This is given out when the process is reversed. Water passing from the liquid to the solid state (ice), gives out heat enough to raise 142 times its weight one degree of Fahrenheit, and *vice versa*. When steam is converted into water, it gives out heat enough to raise 967 times its weight one degree, and *vice versa*. Hence the latent heat of water is said to be 142; of steam, 967, or in round numbers, 1000.

e. EFFECTS OF HEAT. 1. On bulk, *Expansion*; 2. On State of Aggregation, *Change of State*.

1. Expansion. Bodies expand by heat. Solids are the least expansible; liquids more so; gases the most. Different solids expand unequally, and the same solid irregularly; more for a given increase at high, than at low temperatures. Different liquids expand unequally, and the same liquid expands more at high, than at low temperatures. All gases may be said to expand

alike, and equally at all temperatures. The expansion is $\frac{1}{492}$ of the bulk of the gas at 32° F. for each degree of the thermometer (F.).

2. *Change of State.* By heat solids are converted into liquids; liquids into vapours. Gases and vapours, when remote from their condensing points, may be considered identical. The state of aggregation of a body hence depends upon the temperature, and is not essential. Most gases may be made liquid, liquids solid, and *vice versa*, without inherent change. The elasticity or tension of a vapour depends: 1, upon pressure; 2, upon temperature; when one is increased, *cæteris paribus*, the other increases, and *vice versa*.

f. *MEASUREMENT OF HEAT.* Sensible heat is measured by the expansion of solids, liquids, or gases. The two latter comprise *thermometers*, the former *pyrometers*. Air-thermometers are used for measuring slight changes in temperature,—Differential thermometer. Of liquids, mercury is most used, on account of its low specific heat, and the regularity of its expansion. The scale of thermometers is graduated by the temperature of melting ice and of boiling water, under the ordinary pressure of the atmosphere (30° Bar.). The first point is, in Fahrenheit's scale, 32°; in Reaumur's and the Centigrade, 0°; the second, in F. 212°, in R. 80°, and C. 100°. In *pyrometers*, the expansion of a rod of metal is indicated upon a dial. Specific and latent heat are measured: 1, by the

method of mixture; 2, by measuring the time required for equal weights to cool.

Medical Applications of Heat. Baths, Maceration, Digestion, Infusion, Decoction, Preparation of Extracts in Vacuo, Water Baths, &c. See WATER.

C. MAGNETISM.

Magnetic iron ore possesses the property of attracting iron, and certain other metals, and of communicating its powers to them; a bar of iron or steel thus magnetized is called an artificial magnet. Iron receives and loses magnetism readily, steel with difficulty.

A magnet is found to possess attractive powers principally at its ends, which are called its poles.

If a magnet be suspended freely, it assumes a position nearly north and south. The end which invariably points north, is called the north pole, and *vice versa*. One pole cannot exist without the other; the fragments of a magnet each have poles. The north pole of a second magnet repels that of the first, and attracts its south pole, and *vice versa*.

A piece of iron brought near a magnet has magnetic polarity *induced* in it, and is attracted; the intensity of the attraction depends upon the distance, and is not interfered with by the interposition of neutral substances. This second magnet is capable of inducing magnetism in a third in a less degree, and so on. The line of direction of the magnet, called the magnetic meridian, varies from the

true meridian. This deflection, which is not constant, is called the *variation* of the needle. A magnet free to move in a vertical plane will have a *dip*, which varies with the latitude. The earth is supposed to be a great magnet, and the poles have been discovered, that is, points where the dipping needle was vertical, and the horizontal needle ceased to traverse.

Recent researches, with very powerful magnets, have shown that all bodies are probably more or less influenced by the magnet. Those which are attracted by the magnet are termed magnetics or paramagnetics, those which are repelled are termed diamagnetics.

D. ELECTRICITY

Is supposed to reside in all bodies, and to display its effects when its equilibrium is disturbed. This may be: 1, by *Mechanical* means: statical electricity, frictional electricity, electricity of tension; 2, by *Chemical* means: galvanism, voltaic electricity, dynamical electricity; 3, by *Magnetism*: magneto-electricity; by *Heat*: thermoelectricity. Substances which lose electrical excitement easily are called *conductors*; their opposites, *non-conductors* or *electrics*. Conductors may be made electrics by insulation.

A. STATICAL ELECTRICITY.

Certain bodies when rubbed attract light bodies; when

these have touched, the body is repelled. Bodies attracted by excited smooth glass are repelled by excited resin, and *vice versa*. The electricity of excited smooth glass and its allies is called *positive* or *vitreous*, that of the resin class *negative* or *resinous*.

THEORIES. Franklin's, of a single fluid. Dufay's, of two fluids.

Induction. An excited body induces in those around it an opposite electrical state: mutual attraction takes place. The equilibrium may be restored by contact, through the medium of a conductor, or by the passage of the *electric spark*.

Means of accumulating Electricity. Electrical machines, Hydro-electric apparatus, Leyden jar, Electrophorus.

Measurement of Electricity. Electrometers, Electroscopes.

Effects of Electric Spark. Shock, disruption, ignition.

Theory of Thunder-Storms. Lightning rods—their theory and mode of construction are treated of in detail in the works on physics and general chemistry.

Treatment after Thunderstroke. Cold affusion, frictions, stimulants.

B. DYNAMIC ELECTRICITY. GALVANISM.

When two dissimilar conducting bodies are plunged into a liquid capable of acting unequally upon them, and a

communication is made between them, the more assailable metal will be vigorously attacked. The electricity developed by the chemical action is constantly given off, in order to equalize the electrical condition, which is as constantly disturbed, and the so-called electrical *current* is thus kept up. The direction of the current is from the plate most acted upon through the liquid to the plate least acted upon, and through that plate and its conducting wire, to the plate most acted upon. A single arrangement of this kind is called a simple voltaic cell; when several are placed in series, it is called a *battery*. The *quantity* of electricity produced is in proportion to the size of the plates; its *intensity* to their number.

Various forms of Batteries. Daniell's, Smee's, Grove's, Bunsen's, Callan's, Gas batteries, &c.

EFFECTS OF THE ELECTRICAL CURRENT.—1. Physical; 2. Chemical; 3. Physiological.

1. *Physical*—belong more particularly to natural philosophy. *a.* Deflagration of metals and of charcoal points is produced by a battery of large size and intensity. *b.* A current of electricity passed near a magnetic needle, causes it to arrange itself at right angles to the direction of the current, and to revolve around it, the direction of the revolution depending upon that of the current. On this fact is constructed the galvanometer. A current of electricity passed in a helix around a bar of soft iron converts it into a magnet (*electro-magnet*). *c.* When a wire carry-

ing a current is placed beside another wire not so employed, a current in opposite directions to that in the first will be perceived in the second wire whenever the contact of the first with the battery is made and broken,—induced current. This induced current is capable of inducing currents in a third, and this in a fourth wire.

Construction of Electro-magnetic Machines.

2. *Chemical.* Conducting compounds brought between the poles (electrodes) of a battery are decomposed, the electro-negative element going to the positive pole, that connected with the conducting plate, and *vice versa*. The amount of decomposition is in exact relation to the quantity of electricity passing through the conductors, and to the chemical equivalents of the substances liberated from combination.

3. *Physiological.* Electricity passed through a nerve, in the direction of its ramifications, causes contraction; in an opposite direction, less contraction and pain. It excites nerves of special sense. It excites muscles to contraction when passed across them. Organs are stimulated by it to the performance of their proper functions. It promotes absorption, and may be made the means of introducing medicinal substances into the system directly. Currents of electricity have been found to exist in animals,—mucocutaneous current, current from muscular contraction. Certain animals, as the *gymnotus*, have the power of giving electric shocks.

Medical applications of Electricity. Electricity has been successfully used in paralysis, both of motor nerves and of nerves of general and special sense, rheumatism, atony of organs, uterine hemorrhage, tumours, morbid deposits, chorea, neuralgia, in narcotic poisoning, &c. The direct current, of considerable quantity and low intensity, has been found most successful. In cases of narcotic poisoning a decided shock is requisite, and a powerful induced current is preferred. When the current is introduced beneath the surface, by means of fine platinum needles, the process is called electro-puncture.

C. MAGNETO-ELECTRICITY.

If two wires connected with a galvanometer be attached to the soft iron keeper of a powerful magnet, the needle will be deflected when the armature is brought in contact with the magnet; it soon resumes its original position, however, and is deflected equally to the other side, where the contact is broken. By means of an apparatus by which these contacts are rapidly made and broken, and the current maintained in one direction, all the effects of an electric current are produced. Such an apparatus is termed a magneto-electric machine.

D. THERMO-ELECTRICITY.

When two dissimilar metals are joined, and one ex-

tremity heated, an electrical current is perceived flowing from one to the other. A single metal may be made to show the same effects by twisting it on its axis and heating one end. When a number of thermo-electric pairs are united, and their extremities connected with a delicate galvanometer, an apparatus is produced which may be used to measure exceedingly minute differences of temperature. This is called a *thermo-multiplier*.

PART II.

INORGANIC CHEMISTRY.

NOTE. Elements and Compounds in small capitals are important, those in italics less so, those in ordinary type unimportant. When a substance has been described, this distinction is not observed, unless reference is intended.

An asterisk prefixed denotes the substance to be *official* (in the U. S. Pharmacopoeia).

TABLE OF ELEMENTS,

WITH THEIR SYMBOLS AND CHEMICAL EQUIVALENTS.

ELEMENT.	SYMBOL.	EQUIVALENT.
OXYGEN,	O,	8.
HYDROGEN,	H,	1.
NITROGEN,	N,	14.
CARBON,	C,	6.
SULPHUR,	S,	16.
Selenium,	Se,	39.57
PHOSPHORUS,	P,	32.02
CHLORINE,	Cl,	35.5
IODINE,	I,	126.36
BROMINE,	Br,	78.26
<i>Fluorine,</i>	F,	18.70
<i>Boron,</i>	B,	10.90
<i>Silicium,</i>	Si,	21.35

ELEMENT.	SYMBOL.	EQUIVALENT.
POTASSIUM (Kalium),	K,	39.00
SODIUM (Natrium),	Na,	22.97
Lithium,	Li,	6.43
BARIUM,	Ba,	68.84
Strontium,	Sr,	43.84
CALCIUM,	Ca,	20.
MAGNESIUM,	Mg,	12.67
ALUMINUM,	Al,	13.69
Glucinum,	Gl,	26.50
Zirconium,	Zr,	83.62
Yttrium,	Y,	32.20
Norium,	No,	?
Erbium,	E,	?
Terbium,	Tb,	?
Thorium,	Th,	59.59
MANGANESE,	Mn,	27.67
IRON (Ferrum),	Fe,	28.
Chromium,	Cr,	28.15
Vanadium,	V,	68.55
Tungsten,	W,	94.64
Molybdenum,	Mo,	47.88
Tin (Stannum),	Sn,	58.82
Bismuth,	Bi,	70.95
Tellurium,	Te,	66.14
ARSENIC,	As,	75.
ANTIMONY (Stibium),	Sb,	129.03
LEAD (Plumbum),	Pb,	103.56
COPPER (Cuprum),	Cu,	31.66
ZINC,	Zn,	32.52

ELEMENT.	SYMBOL.	EQUIVALENT.
Uranium,	U,	60.
Cerium,	Ce,	46.
Lantanum,	Ln,	48.
Didymium,	D,	49.6
Titanium,	Ti,	24.29
Tantalum,	Ta,	92.30
Niobium,	?	?
MERCURY,	Hg,	200.
SILVER (Argentum),	Ag,	108.
Gold (Aurum),	Au,	98.33
Platinum,	Pt,	98.68
Palladium,	Pd,	53.27
Iridium,	Ir,	98.68
Osmium,	Os,	99.56
Rhodium,	R,	52.11
Ruthenium,	Ru,	52.11
Ilminium,	Il,	60.4

I. OXYGEN, O. 8.

Nat. Sources. Air, water, most rocks, most animal and vegetable substances.

Preparation. Heat *CHLORATE OF POTASSA. O is given off, and chloride of potassium remains. $KO_3ClO_5 = K_2Cl$, and 6 equiv. O.

Modes of collecting, transferring, and storing gases.

Properties. Colourless, inodorous, tasteless, transparent, permanently elastic gas. Specific Gravity 1.106 (Reg.), very sparingly soluble in water. Combustibles burn in it

with increased brilliancy; the only supporter of animal life.

Physiological Effects. Stimulant—converts venous into arterial blood.

Uses in Medicine. Certain cases of suspended animation.

General Chemical Relations. Has an extensive range of powerful affinity—combines with all the other elements except Fluorine, forming OXIDES. When the process is slow it is termed *oxidation*; when rapid, with the evolution of light and heat, *combustion*. Oxides are either ACID, BASIC, or NEUTRAL. As a general rule, the *higher* oxides are *acids*; the *non-metallic* elements form more stable *acids* with oxygen than do the metals; the oxides of the metals are generally *basic*, and those of the non-metallic elements *not acid*, neutral. See METALS.

II. HYDROGEN. H. 1.

Nat. Sources. Water, Organic Substances.

Prep. By removing O, from water. Generally by adding Zinc to dilute Sulphuric Acid; Hydrogen is given off, and SULPHATE OF THE OXIDE OF ZINC remains.
 $\text{SO}_3\text{HO} + \text{Zn} = \text{ZnO}, \text{SO}_3 + \text{H}_2$.

Prop. Colourless, inodorous, tasteless, transparent, permanently elastic gas, lightest of all known substances, specific gravity 0.0693. Combustible, but extinguishes

flame. Mixed with O in nearly atomic proportion and ignited, explodes violently ; the two gases burned, mixed in a jet, give a heat of the highest intensity. (The compound blowpipe.)

Physiological Effects. Inhaled diluted innoxious ; gives a peculiar shrillness to the voice.

Gen. Chem. Rel. Those of the metals which it replaces in combinations. Combines directly with certain elements to form *Hydrides*.

Forms with O three combinations :—

- A. *WATER or Protoxide of Hydrogen, HO.
- B. Binoxide of H, HO₂.
- C. Ozone, HOO?. One form of ozone is considered to be an allotropic condition of pure oxygen.

A. *WATER, HO, 9.

Nat. Sources. Wells, springs, rivers, the atmosphere, &c.

Prep. May be made by burning H in O, or air. Cavendish's Experiment.

Properties. Transparent, liquid, without colour, taste, or smell. Sp. Gr. 1; the assumed standard for all solids and liquids. A cubic inch at 60° weighs about 252.2 grains. It is slightly compressible. At 32° becomes converted into a crystalline solid, *ice*, of a specific gravity 0.916. At 30 in. Bar. boils at 212°; becoming converted into steam, but it evaporates at all temperatures. Is always present in the atmosphere.

Gen. Chem. Relations. A neutral body, frequently acting the part of an acid or a base, forming with alkalies and acids definite compounds, called *Hydrates*. The most universal of all solvents.

Impurities. Most usual are carbonate and sulphate of lime, and chloride of sodium. If in large proportion, the former renders the water *hard*; the latter *brackish*. Water of town wells contains nitrates and ammonia. Rain-water may contain a little nitric acid, if formed during electrical discharges. Water always contains air, and frequently carbonic acid in solution. Organic matter is also generally present.

Modes of Softening and Purifying. Boiling, addition of muriate of ammonia or lime-water, to remove carbonate of lime. Filtration gets rid of solid particles, but distillation is necessary in order to free it from organic matters and certain salts, as the sulphate of lime, and chloride of sodium.

Officinal Forms. a. *AQUA. Common water in its purest attainable state.

b. *AQUA DESTILLATA—DISTILLED WATER. R. *Aquæ cong.* x. Distil two pints and reject, then distil *cong.* viii.

c. AQUÆ MEDICATÆ—MEDICATED WATERS. Are preparations composed of water impregnated with medicinal substances—generally the *essential oils*.

Maceration is the long-continued steeping of a sub-

stance in cold water, 60° to 90°. *Digestion*, the same in hot water, 90° to 100° or more. *Infusion*, the subjecting of a vegetable substance for a short time to hot or cold water. *Decoction*, boiling the substance. *Lixiviation*, the separation of a soluble substance from a porous, insoluble one, by pouring water on it. When a substance is simply dissolved in water, it is called a *solution* (liquor). When suspended, a *mixture* (*mistura*) or *emulsion*. When the solution is made by infusion or decoction, the process gives the title to the preparation—*Infusum*, *Decoctum*.

III. NITROGEN. N. 14.

Nat. Sources. Air, most animal, many vegetable substances—the **NITRATES**.

Prep. By withdrawing O from air. Generally by burning **PHOSPHORUS** in air over water; **PHOSPHORIC ACID** is produced, which is absorbed by the water and nitrogen remains.

Prop. Colourless, inodorous, tasteless, transparent, permanently elastic gas, very sparingly soluble in water; specific gravity 0·971. Does not support combustion nor animal life when pure, but is innoxious when diluted; properties generally negative.

Gen. Chem. Rel. Inert; unites directly with few elements, and with difficulty. It forms with O, five compounds.

- B. NO , *Protoxide of Nitrogen*; nitrous oxide.
- C. NO_2 , *Binoxide of Nitrogen*.
- D. NO_3 , Nitrous Acid.
- E. NO_4 , *Hyponitric Acid*.
- F. $*\text{NO}_5$, NITRIC ACID.
- G. With $\text{H}-\text{NH}_4$, AMMONIUM.

Besides these, we have the A. ATMOSPHERE; a mixture of about 1 vol. of O, to 4 of N.

A. THE ATMOSPHERE.

Extent. Is supposed to extend about 45 miles above the surface of the earth.

Density and Weight. Is inversely as the square of the distance from the surface. At 2·7 miles one-half; at 5·4 one-fourth, &c. One hundred cubic inches, at 30 in. (Bar.) and 60° (F.), weigh 30·829 grains.

Pressure. Is due to the weight of a column of air of decreasing density 45 miles high; it is at the surface of the earth on an average 15 lbs. to the square inch. This is equal to the pressure of a column of water 34 feet, or of mercury 30 inches high. The ordinary *barometer* is a column of mercury in an exhausted tube, sealed at its upper end, and the lower end of which dips into an open cup containing mercury. The pressure of the air on the mercury in the cup maintains that in the tube at a height which varies with that pressure, the variation being indicated by a scale affixed near the upper end of the mercurial column. The

elasticity, bulk, and density of the atmosphere obey the laws of all gases; that is, the volume is *inversely* as the pressure; the density and elastic force are *directly* as the pressure, and *inversely* as the volume. (Marriott's law.)

Composition. Contains in 100 parts by volume 79.10 of N, 20.90 O, with about .0004 of CARBONIC ACID; also a trace of AMMONIA, probably in the state of carbonate, carbonetted hydrogen, moisture, animal and vegetable emanations, &c. When the moisture exceeds the capacity of air to hold it in solution, it is deposited as cloud, fog, mist, or rain. The capacity of air for moisture is increased by heat. The amount of moisture in the air is estimated by *hygrometers*, and by allowing it to deposit on a cold surface and noting the temperature at which this deposition commences. This is termed the *dew point*, and is higher in a moist atmosphere, and *vice versa*. These facts are true of all gases. *Dew* is the moisture deposited upon the surface of the earth, which has cooled by rapid radiation; clouds prevent this radiation, and the deposit of dew.

Effects of Respiration and Combustion. These processes alike remove the oxygen, and convert it into carbonic acid, the nitrogen remaining unchanged. Plants absorb carbonic acid, assimilate the carbon, and give out the oxygen.

Ventilation. The process by which vitiated air is removed, and its place supplied. It may be spontaneous,

due to the levity of vitiated air warmed during the change, or by contact with heated bodies, causing it to rise, while cooler and purer air enters below. This is the process constantly going on, on a grand scale, on the earth, causing winds and currents. 2. Forced, when the current is aided by heat (chimneys), or mechanical means, (fans and steam-jet.) The direction of the flow may be upwards or downwards; the former being the simplest and best adapted for small rooms, the latter the most equitable and economical as regards heat, and applicable to large buildings. Care must be taken to *diffuse* the entering air, to avoid currents; and the regulation of its temperature, hygrometric condition, and amount, are problems which present in practice considerable difficulty in their solution.

B. PROTOXIDE OF NITROGEN, NO, 22.

Prep. By heating nitrate of ammonia, which is resolved into water and NO. NH_4O , $\text{NO}_5 = 2\text{NO}$ and 4HO .

Prop. A colourless, transparent gas; sweetish taste and smell; has been liquefied; combustibles burn in it with nearly as much vividness as in oxygen; detonates with hydrogen; specific gravity, 1.52. Distinguished from O by its greater density and solubility in cold water, which dissolves about three-fourths its volume. It is a neutral body.

Physiolog. Effects. Highly exhilarating, or intoxicating; hence its common name of "laughing gas."

c. BINOXIDE OF NITROGEN NO_2 , 30.

Prep. By deoxidizing NITRIC ACID (q. v.), by a metal.

Prop. Colourless, transparent gas; slightly soluble in water.

Gen. Chem. Rel. Has a powerful affinity for O; exposed to the air or oxygen absorbs two eq., becoming NO_4 . Is neutral.

Physiolog. Effects. Causes spasm of the glottis, and cannot be inhaled. Corrosive; stains the skin yellow.

d. Nitrous Acid, NO_3 . Unimportant.

e. *Hyponitric Acid*, NO_4 , 46.

Prep. Is formed when NO_2 is exposed to the air, or oxygen.

Prop. Appears as ruddy fumes, of a suffocating odour; may be obtained as a volatile liquid, boiling at 82° , of a red or orange colour. Solid at -40° .

Gen. Chem. Rel. Constitution uncertain. Neutral. Powerful oxidizing agent.

f. *NITRIC ACID. NO_5 , 54.

Prep. Add Sulphuric Acid to Nitrate of Potassa

or Soda, NO_5 is given off, and SULPHATE OF POTASSA remains. KO_2NO_5 , and $\text{SO}_3 = \text{KO}_2\text{SO}_3$, and NO_5 . May be obtained anhydrous by treating dry NITRATE OF SILVER with dry CHLORINE.

Prop. Pure hydrated Nitric Acid is a colourless liquid. Specific gravity 1.522; boils about 184° F.; congeals at —40°; fumes when exposed to the air from attraction of moisture. Exceedingly corrosive, and one of the strongest acids.

Gen. Chem. Rel. Forms NITRATES, all of which are soluble, and deflagrate with combustibles from the evolution of O, and of which those of Potassa, the oxides of Iron, Lead, Bismuth, and Mercury, are officinal. Powerful oxidizing agent, losing three equiv. of O, and becoming NO_2 . Added concentrated to a metal, it oxidizes it, and then combines with the oxide so formed. Ex.: 3Cu , and $4\text{NO}_5 = 3\text{CuO}, \text{NO}_5$, and NO_2 , binoxide of N being given off.

Toxicol. Effects. An irritant poison. Antidotes: alkalies, soap, chalk, magnesia, &c.; mucilaginous and oily drinks, and enemata.

Impurities. Sulphuric Acid, Hydrochloric Acid, Iron, Iodine.

Tests. Bleaches a boiling solution of *Sulphate of Indigo*. Mix with strong SULPHURIC ACID, and add strong solution of PROTOSULPHATE OF IRON, a rose or purple tint results. Add HYDROCHLORIC ACID in the presence of GOLD, which is then dissolved. Convert into nitrate of POTASSA, and examine properties.

Officinal Forms. a. *ACIDUM NITRICUM. NITRIC ACID, of the specific gravity 1·42.

b. *ACIDUM NITRICUM DILUTUM. DILUTE NITRIC ACID. *Acid. Nitric.* fʒj. *Aq. destillatae* fʒvi.—Dose, gtt. xx. to xl. t. d.

Therap. Effects. Tonic, astringent; stimulates the secretion of the liver; externally caustic, or, when dilute, astringent and stimulant; used in caries to dissolve the earthy particles.

Incompatibles. All alkalies; all earths; the metals generally; the salts of the weaker acids, as the carbonates, acetates, chlorides, phosphates, and tartrates.

g. AMMONIUM, NH₄, will be considered under METALS.

IV. *CARBON. C. 6.

Nat. Sources. Diamond, graphite, coal, all organic substances, the CARBONATES.

Properties. Vary with the form; is dimorphous; insoluble in menstrua, volatilized only in the voltaic arch, infusible.

Gen. Chem. Rel. Chemically indifferent at a low temperature. At high temperature combines with metals, forming CARBIDES. Unites indirectly with other elements. At high temperatures affinity for O very strong; will remove it from its most powerful combinations. Hence

used as a *reducing agent*. Forms with O, *Carbonic Oxide*, CO, *Oxalic Acid*, C_2O_3 , *Carbonic Acid*, CO_2 , and *Croconic*, *Mellitic*, and *Rhodizonic acids*, which are unimportant. Combines indirectly with II to form an extensive class of hydrocarbons, most of which belong to Organic Chemistry. With N it forms *CYANOGEN*, NC_2 , and *Mellon*, N_4C_6 .

Officinal Forms. a. *CARBO LIGNI. WOOD CHARCOAL.

Prop. Black, shining, brittle, tasteless, inodorous, insoluble, fixed, solid. Absorbs many times its own volume of certain gases. Hygroscopic. Causes rapid oxidation and decomposition of animal substances imbedded in it, without offensive smell.

Therap. Effects. Antiseptic, absorbent, tonic.

b. *CARBO ANIMALIS. ANIMAL CHARCOAL. Charcoal prepared from bones. This contains Carbonate and Phosphate of Lime, which, when removed by *digestion* with HYDROCHLORIC ACID, leave us the c. *CARBO ANIMALIS PURIFICATUS—PURIFIED ANIMAL CHARCOAL.

Prop. A brownish-black powder, which should give no trace of lime when treated with Hydrochloric Acid.

Gen. Chem. Rel. Possesses the remarkable property of decolourizing organic substances, also of removing most organic and many inorganic substances from solution. Given with or soon after the organic POISONS, prevents their

action. Hence may be valuable in certain cases, as an ANTIDOTE.

Therap. Effects. Those of CARBO LIGNI.

A. Carbonic Oxide, CO, 14.

Prep. Formed when Carbon is burned with an insufficient supply of oxygen. Also by adding OIL OF VITRIOL (HO_3SO_3) to OXALIC ACID, which is thereby deprived of its water, and splits up into CO and CO_2 ($\text{CO} + \text{CO}_2 = \text{C}_2\text{O}_3$), which latter may be absorbed by caustic lime or potassa.

Prop. Resembles in physical properties NITROGEN; specific gravity, 0.968; burns in air with a pale blue flame, forming CO_2 ; very sparingly soluble in water.

Gen. Chem. Rel. Neutral; may be considered as the radical of a series of compounds, mostly organic.

Physiolog. Effects. Fatal to life, even when diluted, producing coma; frequently escapes from stoves. Treatment, by cold affusion, frictions, electricity, and other general measures.

B. OXALIC ACID, $\text{HO}_2\text{C}_2\text{O}_3$.

Nat. Sources. Certain plants (*Oxalis*, *Rumex*).

Prep. Action of NO_5 upon SUGAR.

Prop. Long, four-sided oblique prisms, of an acid taste; resembles in appearance *SULPHATE OF MAGNESIA, for which it is often taken by mistake; contains 3 eq. water, two

of crystallization, which may be driven off by heat, and one constitutional, which if removed causes decomposition; exists therefore only in combination with a base; soluble in 8 parts water, at 59° F., and its weight of boiling water.

Gen. Chem. Rel. Forms OXALATES.

Test. LIME, a white precipitate.

Toxicol. Effects. Irritant Poison.

Antidote. LIME. (Chalk, plaster.)

c. CARBONIC ACID, CO₂, 22.

Nat. Sources. The atmosphere, native CARBONATES; is formed during respiration and combustion.

Prep. Decompose a Carbonate; add Hydrochloric Acid to fragments of chalk or marble (CaO, CO₂ and HCl = HO, CaCl and CO₂).

Prop. Colourless, transparent, tasteless, inodorous gas; specific gravity, 1·529; extinguishes flame. Cold water dissolves its own volume. Imparts a pungent, agreeable taste to fermented drinks. May be liquefied by pressure, forming a colourless liquid of a specific gravity, 0·83; and of great elastic force. At —72°, becomes solid.

Gen. Chem. Rel. An acid; reddens litmus, and forms salts, the CARBONATES, of which those of *Potassa*, *Soda*, *Lime*, *Magnesia*, *Iron*, *Lead*, and *Zinc*, are officinal. From its volatile nature these are easily decomposed by heat and acids. The carbonates of the strong alkalies have an alkaline reaction.

Toxicol. Effects. When pure, causes instant suffocation; when largely diluted, poisonous, producing narcotic symptoms. Treatment, that laid down under CO. To remove it from wells and pits, where it has accumulated, an upward draught should be created by a windsail or fire, and the gas absorbed and driven out by throwing down water, or preferably *milk of lime*.

OFF. PREP. a. *AQUA ACIDI CARBONICI—CARBONIC ACID WATER. *Mineral Water.* Water impregnated with five times its bulk of CO₂.

Prop. A sparkling liquid, of an agreeable, pungent, acidulous taste; reddens litmus.

Impurities. LEAD and COPPER, derived from the “fountain.”

Therap. Effects. Used in fevers, vomiting, &c., and as a vehicle for nauseous compounds.

d. CYANOGEN, NC₂ (Cy), 27.

Prep. Heat BICYANIDE OF MERCURY.

Prop. Colourless gas; specific gravity, 1.806; has a peculiar odour, resembling peach kernels; burns with a peach-coloured flame, generating CO₂, and liberating N. Water dissolves 4 or 5 volumes. May by cold and pressure be reduced to a thin, colourless, transparent liquid.

Gen. Chem. Rel. A quasi elementary substance, resembling in its chemical relations the HALOGENS. Forms with Oxygen, Cyanic Acid, CyO, Fulminic Acid, Cy₂O₂,

and Cyanuric Acid, C_3O_3 ; with the metals, CYANIDES, of which those of Potassium, Silver, and Mercury are officinal; and with Hydrogen, the *HYDROCYANIC ACID.

a. *HYDROCYANIC ACID, HCy, 28.

Prep. Anhydrous. By passing a current of HS over BICYANIDE OF MERCURY. (Vauquelin.) Other processes are found in the works on General Chemistry.

Prop. Colourless, transparent, inflammable liquid; very volatile; boils at 80° ; congeals at 5° ; specific gravity, 0.697; taste cooling and burning; flavour of bitter almonds; odour peculiar, and produces headache and giddiness; dissolves readily in water and alcohol. A violent poison. Readily decomposes.

Gen. Chem. Rel. A feeble acid; forms with bases CYANIDES and water. See CHLORINE.

Officinal Forms. 1. *ACIDUM HYDROCYANICUM DILUTUM—*DILUTE HYDROCYANIC ACID.

Prep. 1. By the action of dilute SULPHURIC ACID upon FERROCYANIDE OF POTASSIUM. This is the first process of the U. S. P., and adopted upon the large scale. The theory of the process is complicated.

2. By adding dilute HYDROCHLORIC ACID to CYANIDE OF SILVER—CHLORIDE OF SILVER and dilute HYDROCYANIC ACID result. This is the process of the U. S. P. for extemporaneous preparation of the dilute acid: 1. *Acid. Muriat.* gr. xli; 2. *Argent. Cyanid.* gr. lss.;

3. *Aq. Dest. f 3iss.*; mix 1 with 3, and add 2; when the precipitate has subsided, pour off the separated liquor for use.

Properties, &c. The medicinal acid contains 2 per cent. of real acid, and possesses the same general properties in a less degree. It is prone to decomposition, and should be kept in blackened, well-stopped bottles. It may contain SULPHURIC and MURIATIC ACIDS, which do not injure it, except so far as they vary the strength.

Therap. Effects. Sedative, antispasmodic; given in pertussis, phthisis, chronic bronchitis, aneurism, hypertrophy of the heart, &c.; also to allay nausea, vomiting, and gastralgia; externally as a lotion to allay itching in skin diseases.

Dose of the Medicinal Acid—1 to 5 drops, three times a day. *Scheele's acid*, which contains 5 per cent., should never be used.

Incompatibles. Alkalies, Nitrate of Silver, Salts of Iron, Copper, and Mercury. *TINCTURA OPII CAMPHORATA. (*Paregoric.*)

Toxicological Prop. In large dose kills; one and a half drops of the Anhydrous Acid, equal to f 3vi. of the medicinal acid, having proved fatal to an adult. It is rapidly absorbed into the circulation, so that antidotes can rarely be applied. The best are CHLORINE and AMMONIA, given internally and cautiously inhaled. General treatment is most to be relied upon, and the most efficient is the cold douche to the spine. Salts of the Sesquioxide of

IRON, followed by alkaline carbonates, have been proposed as antidotes. Insoluble ferrocyanide of iron (Prussian Blue) being formed.

Tests. Must be applied early, from the volatile and unstable nature of the poison. The principal are: 1. Its peculiar odour. 2. *Scheele's.* Add to the suspected liquid a few drops of a solution of the SULPHATE of the PROTOXIDE of IRON, and an excess of CAUSTIC POTASSA; expose the whole to the air for 15 minutes, with agitation, then add HYDROCHLORIC ACID in excess; this dissolves the oxide of iron, and if H_{Cy} be present, leaves an insoluble blue powder, the PRUSSIAN BLUE. 3. *Liebig's (modified by Taylor).* Put the suspected liquid into a watch-glass, over which invert another, containing a drop of *Bihydrosulphate of Ammonia*. Heat the lower glass, when, if H_{Cy} be present, it is disengaged, combines with the *Bihydrosulphate of Ammonia* to produce *Sulphocyanate of Ammonia*. Remove the upper glass, evaporate to dryness, and add a drop of the *solution* of the SESQUIOXIDE OF IRON, when a deep blood-red colour is produced, owing to the formation of the *Sulphocyanide of Iron*. This is a very delicate test. Sulphocyanogen exists in human saliva.

E. HYDROCARBONS.

The members of this extensive and important group all belong, strictly speaking, to Organic Chemistry. The gases containing C and H, are generally admitted into in-

organic chemistry. These are C_2H_4 , marsh gas, and C_4H_4 , olefiant gas. Ordinary illuminating gas, is a mixture of these with certain other gases. When burned, the H unites with the O of the atmosphere, while the C is precipitated in fine particles, which become incandescent, giving the luminous character to the flame. If the O be in excess, the gas is burned without decomposition, and the flame is blue and not luminous.

Nature and Structure of Flame. The term flame, is applied to volatile matter in a state of ignition. Solid substances, heated so as to become luminous, are said to be incandescent. Ordinary flame is hollow. The interior consists of volatile matter, strongly heated; there is next a luminous layer or cone, and outside a yellow flame, of feeble light but great heat, where chemical union is most entire. When urged by the *blow-pipe*, the flame is elongated, and the heat increased. The outer flame is called the *oxidizing* flame, the inner one the *reducing* flame, from their respective effects.

Flame will not pass through long tubes, if of small diameter, but the combustible matter becomes cooled below the point necessary for combustion. Wire gauze, which may be considered as a number of very short tubes of small diameter, possesses the same property. A lamp, covered with wire gauze, may be carried into an inflammable gaseous mixture, without causing combustion,—the *safety lamp*.

V. *SULPHUR. S. 16.

Nat. Sources. Native near volcanoes; the native SULPHIDES and SULPHATES; certain organic substances.

Prep. Obtained by sublimation from its earthy impurities. If the vapour be condensed in a liquid state, it is cast into rolls, forming *roll sulphur*, or *brimstone*. If condensed in a cold vessel, it is in fine crystals, known as *flowers of sulphur*,—the *SULPHUR of the U. S. P.

Prop. Pale lemon-yellow, brittle, volatile, insipid, emitting a peculiar odour when rubbed or heated; soluble in OIL OF TURPENTINE, Bisulphide of Carbon, in solutions of the ALKALIES, but not in water or alcohol. Fuses at 234° , boils at 788° , and may be distilled without change; takes fire below boiling-point, giving off suffocating fumes of Sulphurous Acid (SO_2). Is dimorphous. Specific gravity varies with form of crystal; is about 2.

Allotropic Modifications. About its melting-point forms a clear, thin, amber-coloured liquid, fluid as water; as the temperature is raised becomes thicker; at about 480° , is dark-brown, viscid, and tenacious, without increase of density; in this state, if thrown into water, forms a soft, transparent, tenacious solid, which retains its properties for some time, but returns finally to the original hard, opaque, yellow condition. From 500° to its boiling-point, 788° , it begins to become thin again, and if allowed to cool, returns through the same conditions.

Gen. Chem. Rel., resembles oxygen very closely. Forms SULPHIDES, which are analogous to OXIDES. It unites with O, to form seven compounds, of which only two will be considered,—*Sulphurous Acid*, SO_2 , and *SULPHURIC ACID, SO_3 . With H it forms HYDROSULPHURIC ACID, HS, and Bisulphide of H, HS_2 ; with N, the Sulphide of N, NS_3 ; with C, the *Bisulphide of Carbon*, CS_2 .

Officinal Forms. a. *SULPHUR—SUBLIMED SULPHUR. This contains often a little SULPHURIC ACID, which may be removed by washing, constituting the

b. *SULPHUR LOTUM—*Washed Sulphur*. Its washings with boiling water should not affect blue *litmus paper*.

c. *SULPHUR PRÆCIPITATUM—PRECIPITATED SULPHUR, *Lac Sulphuris, Milk of Sulphur*. Is made by adding HYDROCHLORIC ACID to *Sulphide of Calcium*.

Prop. Pale, or yellowish-green, insipid powder, having a harsh feel when rubbed, and a peculiar odour. Does not differ essentially from ordinary sulphur; probably contains a portion of hydrosulphuric acid.

Adulterations, may contain free acid; but more commonly sulphate of lime, from the use of sulphuric acid in its preparation. Readily detected by exposure to heat, which drives off the volatile sulphur, leaving the fixed sulphate of lime.

d. *UNGUENTUM SULPHURIS—*Sulphur Ointment*.

R. *Sulphuris libj*; *Adipis libj*. M.

e. *UNGUENTUM SULPHURIS COMPOSITUM—COM-

POUND SULPHUR OINTMENT. R. *Sulphuri* 3j; *Hydrarg.* *Ammon.*, *Acid. Benzoic* aa 3j; *Ol. Bergami*, *Acid. Sulphuric* aa f3j; *Potass. Nitrat.* 3ij; *Adipis* lbss. Melt the lard at a moderate heat, and stir in the other ingredients until thoroughly mixed.

Med. Effects. Laxative, diaphoretic, alterative. Supposed to be rendered soluble by the soda of the bile. Used in constipation, chronic rheumatism, and gout, asthma, &c. Externally in ointment or fumigation, in cutaneous diseases, chronic rheumatism, &c. *Dose*, one to three drachms.

A. *Sulphurous Acid*, SO_2 , 32.

Prep. Formed when S is burned in air, or O. Made by deoxidizing SULPHURIC ACID.

Prop. Transparent, colourless gas, of a suffocating odour; extinguishes flame; is irrespirable; specific gravity, 2.247. May be obtained liquid by cold, in the form of a very volatile mobile liquid, of a specific gravity, 1.45; boiling at 14°. Water dissolves 50 volumes of this gas. It reddens litmus and bleaches. The colours may be restored by an alkali.

Gen. Chem. Rel. Forms Sulphites.

Therapeutic Application. Used as a vapour bath in treatment of skin diseases, rheumatism, &c.

B. *SULPHURIC ACID, SO_3 , 40.

Prep. 1. Distilling iron pyrites, bisulphide of iron,

which gives the fuming *Nordhausen* acid, HO_2SO_3 . Not used in medicine.

2. By introducing into a leaden chamber, in which is a stratum of water, HYPERNITRIC and SULPHUROUS ACIDS. Several explanations of the theory of the process are given. It mainly depends upon the reduction of the *Hyponitric Acid*, NO_4 , to *Binoxide of Nitrogen*, NO_2 , by which two equivalents of *Sulphurous Acid*, SO_2 , are oxidized to two equivalents of Sulphuric Acid, SO_3 . By contact with the air NO_2 becomes again NO_4 , and thus the process continues as long as the supply of air and gases is kept up.

Prop. It may be obtained anhydrous by distilling the *Nordhausen* acid. It is then in solid fibres, resembling asbestos, which are tenacious, and may be warmed with the fingers like wax; specific gravity, 1.97. Has a powerful attraction for moisture; hisses when thrown into water. Has no acid properties.

The Hydrated Acid (*Oil of Vitriol*, HO_2SO_3) is a clear, colourless, oily fluid; specific gravity, 1.845; most powerful of the acids; is highly corrosive; chars and destroys vegetable and animal tissues. Absorbs water greedily, and must therefore be kept in well-stopped bottles.

Gen. Chem. Rel. Forms an extensive series of stable salts: the SULPHATES, of which those of Potassa, Soda, Magnesia, the oxides of Iron, Zinc, Copper, and Mercury, are officinal. Acts on metals in two ways: 1, when dilute, on those easily oxidized, by the decomposition of water

and evolution of HYDROGEN (q. v.); 2. When concentrated, on those less easily oxidized, by the decomposition of one equiv. of the acid, which yields an equiv. of O to the metal, becoming *Sulphurous Acid*, a second equiv. of the acid uniting with the oxide thus formed, (Cu, and $2\text{SO}_3 = \text{CuO}, \text{SO}_3$ and SO_2 .)

Test. Gives with salts of *Baryta* a white precipitate, insoluble in boiling, NO_5 .

Officinal Forms. a. *ACIDUM SULPHURICUM—SULPHURIC ACID. Sulphuric Acid of the specific gravity 1.845.

This is apt to contain LEAD, NITRE, SULPHATE OF POTASSA, *Nitrous Acid*, and more rarely ARSENIC and Tin, for which the TESTS are given under the respective substances.

b. *ACIDUM SULPHURICUM DILUTUM—*Dilute Sulphuric Acid.* R. Acid. *Sulph.* f $\tilde{\exists}$ i.; Aq. *Destill.* f $\tilde{\exists}$ xii.—Dose, gtt. x. to xxx.

c. *ACIDUM SULPHURICUM AROMATICUM—*Aromatic Sulphuric Acid.* Elixir of Vitriol.

Acid. *Sulph.* f $\tilde{\exists}$ iiiss.; *Zingiber. pulv. crass.* f $\tilde{\exists}$ i.; *Cinnam. pulv. crass.* $\tilde{\exists}$ iss.; *Alcohol.* q. s. Add the acid gradually to Oj. of the alcohol, and allow the liquor to cool; mix the *ginger* and *cinnamon*, put them into a percolator, pour on the *alcohol* gradually until Oj. of filtered liquor is obtained. Lastly, mix the diluted acid and tincture. Dose, gtt. x. to xxx.

Toxicolog. Prop. Corrosive poison. Antidotes. ALKALIES, soap, magnesia, chalk; mucilaginous and oleaginous drinks, and enemata; milk. Water should be sparingly used, on account of the elevation of temperature produced.

Med. Effects. Tonic, astringent, refrigerant. Used in low fevers, chronic and choleraic diarrhoeas, chronic catarrhs, night sweats, purpura, haemorrhages, &c. Externally, concentrated as a caustic, mixed with saffron, *Velpeau's caustic*. Dilute, as an astringent wash.

Incompatibles. All alkalies and earths; the metals generally; the salts of the weaker acids, as Carbonic, Nitric, Hydrochloric, Acetic, Phosphoric, and Tartaric.

c. HYDROSULPHURIC ACID, HS, 17. (*Sulphuretted Hydrogen.*)

Nat. Sources. Certain mineral springs. (Sulphur springs.)

Prop. Sulphur does not unite directly with Hydrogen; but does when both are in the *nascent state*. Generally made by adding dilute SO_3 to SULPHIDE OF IRON. Sulphate of the *protoxide* of IRON is formed, and HS given off. (FeS and $\text{HO}_2\text{SO}_3 = \text{FeO}_2\text{SO}_3$ and HS.)

Prop. Colourless gas, strong offensive odour; specific gravity, 1.191; burns with pale blue flame, producing water and SO_2 . Water at 640 dissolves $2\frac{1}{2}$ volumes; the solution becomes milky on exposure to the air from the pre-

cipitation of the sulphur. May be liquefied by cold and pressure, and at -122° solidifies.

Gen. Chem. Rel. Has a weak acid reaction; precipitates many metals from solution as SULPHIDES. Several of these are characteristic. Hence its value as a TEST.

Toxicolog. Prop. Inhaled pure, causes syncope and death; when dilute, produces narcotic effects; arises from drains and privies; is a frequent product of decomposition. The antidote is CHLORINE, inhaled cautiously, the general means of treating cases of narcotic poison, being employed at the same time. Is decomposed by the so-called disinfectants, as CHLORINE, SULPHATE OF IRON, NITRATE OF LEAD, CHLORIDE OF ZINC, and Sulphate of Manganese.

Therap. Effects. Generally those of sulphur.

d. Bisulphide of Carbon, CS₂.

Prep. Is formed by passing the vapour of S, over charcoal at a red heat.

Prop. Is a volatile, very mobile liquid; of an offensive odour; insoluble in water; specific gravity 1.272; highly inflammable; of high refractive, and low dispersive power.

Uses. Is used to dissolve Sulphur, Phosphorus, &c.; from the great tension of its vapour, has been proposed as a substitute for steam as a motor.

VI. PHOSPHORUS. P. 32·02.

Nat. Sources. Organic substances; the native PHOSPHATES.

Prep. On the large scale from bones, in which it exists as PHOSPHATE OF LIME ($8\text{CaO}, 3\text{PO}_5$), which are: 1. Calcined, to remove animal matter; 2. Digested with SO_3 , which combines with *most* of the LIME, liberating the greater part of the *Phosphoric Acid* (PO_5). This is heated in a close iron retort with *Charcoal*, which combines with the O of the *Phosphoric Acid*, forming CO , leaving the PHOSPHORUS to distil over.*

Prop. A soft, translucent solid, of a waxy appearance; is tasteless; has an alliaceous odour. When perfectly pure, is colourless; ordinarily has a reddish tint, which increases with exposure to light; specific gravity 1·77. It melts at 108° , boils at 550° , giving a colourless vapour. May be distilled unchanged. Emits fumes in the air (Phosphorous Acid, PO_3), which in the dark are luminous; this slow combustion may be prevented by the presence of certain vapours, as *Aether*, *Turpentine*, and *Naphtha*. Very inflammable, taking fire below 140° ; burns with the evolution of copious white fumes of PHOSPHORIC ACID (PO_5). It is insoluble in water and alcohol; soluble in

* The true process and theory are a little more complicated, owing to the existence of superphosphate of lime. The above gives the essential steps of the process and changes.

the fixed and volatile oils, in *AETHER*, and *Bisulphide of Carbon*.

Allotropic Modification. By exposing Phosphorus for a long time to light, or for a shorter time to a temperature between 464° - 482° , it assumes a *red* colour, thickens, and becomes opaque. This *Amorphous Phosphorus* (Schröeter), is unaltered in the air; specific gravity 1.964; insoluble in *Bisulphide of Carbon*; takes fire only at a high temperature. Heated to the boiling-point, in an indifferent gas, becomes again common Phosphorus.

Gen. Chem. Rel. Except for O, affinity not very marked. Forms four oxides: 1. Oxide of P., P_2O ; Hypophosphorus Acid, PO ; Phosphorous Acid, PO_3 ; PHOSPHORIC Acid, PO_5 . With H three compounds: Solid Hydride of P., P_2H ; Liquid Hydride P., PII_2 ; and *Phosphuretted Hydrogen Gas*, PII_3 . Also with N and S, unimportant compounds.

Med. and Tox. Prop. In large dose, an irritant poison of great energy. No direct antidote is known. Evacuate the stomach; give large draughts of cold water, containing magnesia in suspension—one part magnesia and eight of chlorine water (Duflos).

Workmen exposed to its vapours are liable to necrosis, particularly of the lower jaw-bone. In medicinal doses, stimulant, diuretic, and aphrodisiac. Is given in solution in oil; dose, $\frac{1}{10}$ to $\frac{1}{6}$ of a grain. Is not officinal in the U. S. P.

A. PHOSPHORIC ACID, PO_5 .

Prep. Formed *Anhydrous*, when **PHOSPHORUS** is burned in the dry air or O.

Prop. A snow-like, uncryallized mass, resembling solid CO_2 . Deliquescent. Hisses on contact of water, forming a *hydrate*. Is fixed.

Gen. Chem. Rel. Remarkable as forming three distinct classes of salts, which contain respectively one, two, and three equivalents of water, or a base. They are distinguished as the Monobasic Phosphate of Water, or Protohydiate of PO_5 (*Glacial Phosphoric Acid*), HO, PO_5 ; Bibasic Phosphate of Water, or Deuto-Hydriate of PO_5 (*Pyrophosphoric Acid*), 2HO, PO_5 ; and TRIBASIC PHOSPHATE of Water, TERHYDRATE of PO_5 , 3HO, PO_5 . The ordinary phosphates belong to the latter class. The Monohydrated Acid, procured by the action of NO_5 on P, is officinal only in the Edinburgh Ph. **PHOSPHORIC ACID** is a powerful acid, of an intensely sour taste; reddens litmus; is not poisonous. The Phosphates of Soda, and of the Protoxide of Iron, are officinal.

Med. Effects. Refrigerant, tonic. Used in Diabetes, Phosphatic deposits, &c.

Incompatibles. ALKALIES, Salts of Iron, Lead, and Silver; also those of the weaker acids, as Carbonates and Acetates.

B. Hydrides of Phosphorus,

Have already been enumerated—are not employed in

Medicine. A mixture of PH_2 and PH_3 , is known as *Phosphuretted Hydrogen*; and is remarkable for its property of inflaming spontaneously upon the contact of air, producing PO_5 . It has an alliaceous odour, and is injurious when breathed.

VII. CHLORINE. Cl. 35.5.

Nat. Sources. Common salt; the native CHLORIDES.

Prep. By gently heating *Binoxide of Manganese* (MnO_2), with *HYDROCHLORIC ACID (HCl), Chloride of Manganese is formed, and CHLORINE given off (MnO_2 , and $2\text{HCl} = \text{MnCl}, \text{HO}$, and Cl).

Prop. A dense gas, specific gravity, 2.470; of a greenish-yellow colour and peculiar suffocating odour. By pressure is converted into a limpid liquid, of a bright yellow colour; specific gravity, 1.33. Supports combustion. Water at 60° dissolves twice its volume of this gas, acquiring a yellow colour, and the properties of the gas. (The CHLORINÆ LIQUOR of the Dub. Ph.) This solution soon decomposes on exposure to the light, the products being HYDROCHLORIC ACID, and free O.

Gen. Chem. Rel. Forms with IODINE, BROMINE, and Fluorine, a group — the HALOGEN bodies. These are characterized by a feeble affinity for O, and a powerful one for H and the METALS, with which they combine directly.

With H they form acids, the HYDRACIDS, which when added to a base give their H to the O of the base to form water while the HALOGEN combines *directly* with the metal to form the HALOID salt (Ex.: $KO, HCl = HO$ and KCl). Distinguished from the acids formed with O, which always required O in the base, forming AMPHIDE SALTS (Ex. : KO, SO_3). Most of the HALOID SALTS are soluble.

CHLORINE does not unite directly with O, but forms indirectly five compounds : *Hypochlorous Acid*, ClO ; Chlorous Acid, ClO_3 ; Hypochloric Acid, ClO_4 ; *Chloric Acid*, ClO_5 ; Perchloric Acid, ClO_7 . With H it forms the important *HYDROCHLORIC, or *Muriatic Acid*, HCl . It forms, also, compounds with N, S, P. With the metals it forms the extensive and important class of CHLORIDES, of which those of Sodium, Barium, Calcium, Iron, Zinc, Antimony, and Mercury, are officinal.

Chlorine possesses bleaching and disinfecting (?) powers. These depend on its affinity for H. When a moistened vegetable colour is submitted to its influence, it unites with the H of the water, to form HCl , while the *nascent* O bleaches. When it comes in contact with HS, PH_3 , NH_4O , the usual constituents of a *bad odour*, it decomposes them by combining with their H.

Tests. When free, its odour and bleaching powers; when free and as the soluble Chlorides, gives with NITRATE OF SILVER, a white precipitate, *Chloride of Silver*,

which blackens on exposure to light, is soluble in ammonia (NH_4O), but not in cold or boiling NO_5 .

Med. and Tox. Effects. Inhaled pure, causes spasm of the glottis, and suffocation; even when diluted, irritates the nasal, bronchial, and pulmonary mucous membrane, causing coughing, oppression, haemoptysis, &c. Relief is obtained by cautiously inhaling Ammonia or Æther.

Largely diluted, is inhaled as a stimulant in aphonia, chronic bronchitis, and phthisis. Used largely as a detergent and antiseptic wash, and for fumigations of foul localities. Is given internally in Scarlatina, Typhus, &c.

Generally disengaged in practice from its combination with LIME or SODA,—*CALX CHLORINATA, *SODA CHLORINATA.

Incompatibles. Ammonia, Nitrate of Silver; the metals generally.

A. Chloric Acid, ClO_5 .

Prep. Not isolable; exists only in combination with water or a base. By passing a current of Cl into a solution of caustic POTASSA (KO, HO), the CHLORATE of POTASSA is formed, Chloride of Potassium, KCl , remaining in solution. ($6\text{Cl} + 6\text{KO} = \text{KO}, \text{ClO}_5 + 5\text{KCl}$.)

Gen. Chem. Rel. Forms CHLORATES, of which that of *Potassa* is officinal. They are all soluble, and deflagrate and detonate with combustibles.

B. *HYDROCHLORIC ACID (Muriatic Acid), HCl, 36·5.

Prep. Add Oil of Vitriol (HO_3SO_3) to common salt (NaCl). HYDROCHLORIC ACID and *SULPHATE OF SODA result (HO_3SO_3 and $\text{NaCl} = \text{NaO}_3\text{SO}_3$ and HCl).

Prop. An invisible gas, of a pungent acid odour, producing white fumes when escaping into the air, from the attraction of moisture. By pressure condensed into a liquid; specific gravity, 1·27. Extinguishes combustion; is irrespirable. Water at 69° , absorbs 418 volumes of this gas, and the *solution* becomes the ordinary HYDROCHLORIC or MURIATIC ACID. This is a colourless, fuming liquid, of a suffocating odour, and acid, corrosive taste. The most concentrated acid has a specific gravity, 1·21.

Impurities. The commercial acid has generally a yellowish tinge, from the presence of organic matter, or of Iron. It also often contains Sulphuric or Nitric Acids, more rarely Lead and Arsenic.

Gen. Chem. Rel. Is the type of the HYDRACIDS; forms, when added to a base, CHLORIDES, of which that of SILVER is insoluble. Is decomposed by substances which yield oxygen freely; the O combining with the H, and liberating the Cl. Dissolves METALS with the evolution of H (Zn and $\text{HCl} = \text{ZnCl}$, and H_2), forming CHLORIDES; with Nitric Acid forms the *NITROMURIATIC ACID, or *Aqua regia*.

Test. Nitrate of Silver. (See CHLORINE.)

Toxicol. Effects. Irritant poison. Antidotes; alkalies, magnesia, chalk, soap, &c.

Officinal Forms and Preps. a. *ACIDUM MURATICUM—MURIATIC ACID. An aqueous solution of Chlorohydric Acid Gas, of the specific gravity 1·16.

b. *ACIDUM MURIATICUM DILUTUM—*Dilute Muriatic Acid.* R. Acid. Muriat. fʒiv; Aq. Destill. fʒxii. M. Specific gravity, 1·046.

Med. Effects. Those of the mineral acids generally.

c. *ACIDUM NITROMURIATICUM—NITROMURIATIC ACID—AQUA REGIA. R. Acid. Nitric. fʒiv; Acid. Muriat. fʒviii; mix, and when effervescence has ceased, keep the product in a well-stopped glass bottle, in a cool and dark place.

Contains free chlorine, which gives it the power of dissolving *Gold* and *Platinum*. Also contains Chlorohyponitric Acid (NO_2Cl_2), and Chloronitrous Acid (NO_2Cl); Hyponitric Acid (NO_4) is also formed after a time. It is an unstable compound, and should be prepared extemporaneously.

Med. Effects. Supposed, in addition to usual properties of the Mineral Acids, to exert a specific effect on the liver. Is given internally, dose gtt. v, largely diluted; also externally, in baths. Used principally in hepatic and syphilitic diseases, and the oxalate of lime calculous diathesis.

Incompatibles. The alkalies, earths; the carbonates,

acetates, tartrates, sulphides; nitrate of silver; most metals.

VIII. *IODINE. I. 126·36.

Nat. Sources. Sea-weed, sea-water, certain mineral springs, sponge, cod-liver oil, &c.

Prep. Prepared from *kelp*, or ashes of sea-weed, in which it exists as Iodide of Sodium, by a process analogous to that by which CHLORINE is obtained from Chloride of Sodium.

Prop. Crystalline scales, of a bluish-black colour, metallic lustre; specific gravity, 4·948. Evaporates at common temperatures, having an odour resembling CHLORINE, yet distinct from it. Fuses at 225°, boils at 347°, and rises in vapour of a beautiful violet colour; specific gravity, 8·716. Taste, hot and aerid. Communicates an evanescent yellow stain to the skin. Soluble in 7000 parts of water, to which it communicates a brown colour; is rendered freely soluble in water, by the addition of certain salts,—as the IODIDE of POTASSIUM; freely soluble in ALCOHOL and ÆTHER.

Gen. Chem. Rel. Resembles CHLORINE, but its affinities are more feeble. Does not bleach. Forms by indirect combination with O, Iodous Acid, IO_4 , Iodic Acid, IO_5 , and Periodic Acid, IO_7 ; with H, forms HYDRIODIC Acid, HI, an unstable acid, resembling in its general re-

lations HCl. It forms also compounds with N, S, P, and Cl, of which the IODIDE OF SULPHUR is officinal. With metals, forms IODIDES, of which those of Potassium, Iron, Lead, Arsenic, and Mercury, are officinal.

Impurities. May contain charcoal, plumbago, binoxide of manganese; these are readily detected by their *fixed* nature. Water is found sometimes in considerable quantity; is injurious, as rendering the Iodine weaker. May be detected by the Iodine adhering to the sides of the bottle, and removed by quicksilver. *Iodide of Cyanogen* is sometimes present; is more volatile than Iodine, and may be separated by careful sublimation.

Test. Liquid starch. The solutions must be *cold*, and the Iodine *free*.

Officinal Forms. a. **IODINIUM—Iodine.*

b. **TINCTURA IODINII—Tincture of Iodinii.* R. *Iodinii* ʒj; *Alcoh.* Oj. M.

Rem. When first made, precipitates on the addition of water; after keeping, undergoes a change, Hydriodic Acid and other compounds being formed, and then does not precipitate.

Principally used externally. Dose, when given internally, gtt. x to xx, gradually increased.

c. **TINCTURA IODINII COMPOSITA—Compound Tincture of Iodine.* R. *Iodinii* ʒss; *Potassi. Iod* ʒj; *Alcoh.* Oj. M.

Rem. This tincture may be diluted with water without

decomposition, the IODIDE OF POTASSIUM rendering the Iodine soluble in water. Used in the same cases, and dose as the simple tincture.

d. *LIQUOR IODINII COMPOSITUS—COMPOUND SOLUTION OF IODINE—*Lugol's Solution.* R. *Iodinii* ʒvi; *Potass. Iodid.* ʒiss; *Aq. Destill.* Oj. M.

Rem. The Iodine is here rendered soluble in the water, by the IODIDE OF POTASSIUM. It is not liable to change, and is the preparation of Iodine generally resorted to for internal use. Dose, gtt. v. t. d.

e. *UNGUENTUM IODINII—IODINE OINTMENT. R. 1. *Iodin.* ʒj; 2. *Potass. Iod.* gr. iv; 3. *Aquaæ* ʒ vi; 4. *Adipis* ʒi. Rub 1 and 2 with 3, until liquefied, and then mix with 4.

Rem. Does not keep well.

f. *UNGUENTUM IODINII COMPOSITUM—COMPOUND IODINE OINTMENT. R. 1. *Iodinii* ʒss; 2. *Potass. Iodid.* ʒj; 3. *Alcoh.* fʒj; 4. *Adipis* ʒij. Rub 1 and 2 with 3, and then with 4, until entirely mixed.

g. *SULPHURIS IODIDUM. IODIDE OF SULPHUR.

Is made by melting together *Iodin.* ʒiv; *Sulphur* ʒj.

Rem. Grayish-black, solid, of a radiated, crystalline appearance; smell of Iodine. Entirely volatilized by heat, and decomposed by long boiling with water; the I escaping with the watery vapour, and S remaining suspended. Used only externally in ointment. Decomposed by many volatile oils.

1. *UNGENTUM SULPHURIS IODIDI. OINTMENT OF IODIDE OF SULPHUR. *R. Sulphur. Iodid. 3ss; Adipis 3j. M. ft. ung.* Used in cutaneous diseases.

Med. and Tox. Effects. In large doses Iodine is an irritant poison. Antidote, boiled starch.

In medicinal doses, stimulant and alterative.

Externally, causes desquamation of the cuticle.

Incompatibles. The salts of *Iron, Lead, Mercury, Silver.* The metals generally.

IX. *BROMINE. Br. 78·26.

Nat. Sources. Sea-water; saline springs, &c., from which it is obtained by a process analogous to that for procuring Chlorine.

Prop. Opaque, brownish, red liquid. The only element besides MERCURY existing in the liquid form at ordinary temperatures; specific gravity, 2·966; at -10°, freezes. Is volatile at ordinary temperature; has a peculiar disagreeable odour; caustic taste; boils at 116·5°, giving a vapour similar to fumes of NO₄; specific gravity, 5·39. Slightly soluble in water, more so in alcohol and æther. Corrodes the skin, and stains it yellow.

Gen. Chem. Rel. Resembles Chlorine very strongly; bleaches. Forms with O, Bromic A, BrO₅ (not isolable), and with H, Hydrobromic A. Forms compounds (Bromides), with S, P, Cl, I, and most of the metals, of which the

BROMIDE OF POTASSIUM, is officinal. The *Bromides* are decomposed by Cl, but Br decomposes the *Iodides*.

Test. Chlorine water produces an orange-yellow tint in a solution, if Bromine be present.

Med. and Tox. Prop. In overdose, an irritant poison; antidote, Ammonia (Smee).

In medicinal doses, its effects are those of Iodine, for which it is often substituted; is used generally as the
***BROMIDE OF POTASSIUM (q. v.).**

Off. Form. *BROMINIUM. BROMINE.

X. FLUORINE. F. 18·7.

Nat. Sources. Fluor Spar.

Prep. Has never been satisfactorily isolated.

Gen. Chem. Rel. Extraordinary affinity for H, forming *Hydrofluoric Acid*. A corrosive liquid, acting powerfully on glass, by dissolving its Silica. Forms **FLUORIDES**. Is not employed in medicine.

XI. BORON. B. 10·9.

Nat. Sources. Certain lagoons in Tuscany, as Boracic Acid; in Thibet, as *Borax*.

Rem. Only important as forming with O, BORACIC ACID, BO_3 , which, united with SODA, gives the BIBORATE OF SODA ($\text{NaO} \cdot 2 \text{BO}_3$), or BORAX, which is officinal.

XII. SILICON (SILICIUM). Si. 21.35.*

Rem. Exists in nature in combination with O, as Silica, SiO_3 , (Ex.: quartz, sand.) Silica is really an acid, although nearly insoluble; but fused with bases, as Potassa, Soda, Lime, Lead, &c., forms SILICATES. (Ex.: glass or porcelain.) A number of native Silicates are known.

THE METALS.

GENERAL PROPERTIES. Opacity, metallic lustre, malleability, ductility; conduct electricity and heat; Sp. Gr. varies from 0.865 (POTASSIUM), to 22.069(?) (Platinum).

Melting Point. Varies from -39° (MERCURY) to the heat of the compound blowpipe (*Platinum, &c.*).

Volatility. Potassium, Sodium, Zinc, Arsenic, Mercury, Antimony, Copper, Lead, Silver, Cadmium, Tellurium, and probably others, are volatile.

General Chemical Relations. With each other, form ALLOYS. All unite with O, but their affinity varies from that of POTASSIUM, which decomposes water at 32° , to those which are oxidized with difficulty, as *Platinum*.

When they unite with O in more than one proportion, the *lowest* combination is strongly BASIC, the *higher* more

* The experiments of Mr. Gore seemed to prove Silicium to be a metal. Until its relations, as such, shall have been investigated, it has been deemed best to retain it in its position as the last of the non-metallic elements.

feeble so, NEUTRAL or even ACID. Ex.: Protoxide of Manganese, MnO , strongly BASIC; Sesquioxide, Mn_2O_3 , feebly basic; Bioxide, MnO_2 , neutral; Manganic acid, MnO_3 , and Permanganic acid, Mn_2O_7 , strongly acid.

An OXYGEN ACID united with the OXIDE of a METAL forms a salt (*Amphide* salt), which is neutral in composition when there are as many equivalents of ACID in the SALT as there are of O in the BASE. Thus a neutral *protoxide* requires one eq. of Acid, a Bioxide two, and a *Sesquioxide*, three equivalents. A salt, neutral in *composition*, may have an acid or alkaline REACTION. If in a salt the base is oxidized, the *acid* remaining the same, a BASIC compound is formed, which is generally insoluble.

Metals also combine with the other non-metallic elements, as with SULPHUR and the HALOGENS. The SULPHIDES, CHLORIDES, &c., of the metals correspond generally in their *number*, and the proportion of their constituents to the OXIDES. Ex.: FeO , Fe_2O_3 , FeS , Fe_2S_3 , ? $FeCl$, Fe_2Cl_3 , FeI , Fe_2I_3 , &c.

Classification. 1. Metals of the ALKALIES. POTASSIUM, SODIUM, Lithium.

2. Metals of the ALKALINE EARTHS. Barium, Strontium, CALCIUM, MAGNESIUM.

3. Metals of the EARTHS. ALUMINUM, Glucinium, Zirconium, Yttrium, Zerbium, Erbium, Thorium, Norium.

4. METALS PROPER. Cobalt, Nickel, ZINC, Cadmium, Uranium, Cerium, Lantanum, Didymium.

5. Metals proper, whose higher oxides are ACIDS. *Manganese*, IRON, *Chromium*, TIN, BISMUTH, ARSENIC, ANTIMONY, COPPER, LEAD, Vanadium, Tungsten, Molybdenum, Tantalum, Niobium, Titanium, Tellurium.

6. Metals whose oxides are reduced by heat alone. NOBLE METALS. *Gold*, MERCURY, SILVER, *Platinum*, Palladium, Iridium, Ruthenium, Rhodium, Ilmenium, Osmium.

A. *Metals whose Preparations or Compounds are Official*. Potassium, Sodium, Barium, Calcium, Magnesium, Aluminum, Iron, Zinc, Copper, Lead, Tin, Arsenic, Antimony, Bismuth, Mercury, Silver—16.

B. *Metals not official, but used in medicine, or otherwise important*. Strontium, Manganese, Chromium, Gold, Platinum—5.

The others named are unimportant, and will not be again referred to.

XIII. POTASSIUM (KALIUM). K. 39.

Prop. Obtained from POTASSA, KO, by heating with C, which abstracts the O, as CO, leaving K, which distils over.

Prop. A brilliant, white metal, silvery lustre, soft at common temperatures; brittle and crystalline at 32°;

melts at 136° ; distils at a low red heat, giving a vapour of a green colour. Sp. Gr. 0.865. Exists abundantly in combination in all *vegetable* forms.

Gen. Chem. Rel. Strong affinity for O; cut surface instantly tarnishes, becoming covered with a film of POTASSA (KO), which gradually invades the whole mass. In contact with water will abstract the O, taking fire, and liberating H. Forms with O, two compounds, POTASSA, KO, and Teroxide of Potassium, KO_3 .

A. POTASSA, KO, 47.

Prep. Formed by oxidation of Potassa. A *Hydrate*, is made by the action of Caustic LIME on CARBONATE OF POTASSA; CARBONATE OF LIME and CAUSTIC POTASSA result.



Gen. Chem. Rel. One of the strongest bases. Forms salts with all acids; all of which are freely soluble, except the Acid Tartrate, the Carbazotate, and the Double Chloride of Potassium and Platinum. The Hydrate, Nitrate, Carbonates, Sulphate, Chlorate, Acetate, Tartrates, Citrate of Potassa, and the Sulphide, Iodide, Bromide, Cyanide, and Ferrocyanide of Potassium, are officinal.

Tests. Tartaric acid in excess, gives a white precipitate of Acid Tartrate of Potassa; sparingly soluble in water.

Bichloride of Platinum, gives a yellow precipitate of the

Double Chloride of Platinum and Potassium; sparingly soluble in water.

Perchloric, Hydrofluosilic, and Carbazotic Acid (see INDIGO) also give sparingly soluble precipitates.

Incompatibles. All acids, acid salts, the salts of the earths, and metals generally.

Officinal Preparations.

*a. *LIQUOR POTASSÆ—SOLUTION OF POTASSA.*

R. 1. *Potass. Carb.* lbj ; 2. *Calcis* lbss ; 3. *Aq. Dest.* Bull. Cong. j. Dissolve 1 in Cong. ss of 3 ; slake 2 with a little of 3 ; mix the hot liquors, and boil for ten minutes, stirring constantly. Set the liquor aside until it becomes clear, and pour off the supernatant liquid. The Sp. Gr. of this solution is 1·056.

Rem. The theory of the process is given above ; contains about 6·7 per cent. of KO ; always contains a certain amount of free Carbonate of Potassa and Lime ; has a powerful attraction for CO₂, and should be kept in well-stopped, green glass bottles.

Med. Effects. Antacid, antilithic, alterative. In excessive doses a *corrosive poison* ; antidotes, weak acids, as vinegar, mucilaginous and oily drinks.

*b. *POTASSA. Caustic Potassa—Hydrate of Potassa,* made by evaporating down the *Liq. Potassa*, and running the fused potassa into sticks.

Rem. Contains a little Lime and Carbonate of Potassa ; may be purified by solution in alcohol, and evaporation. Should be kept in well-stopped bottles.

Prop. Sticks, of a dingy gray colour, very deliquescent, producing a soapy feel, from destruction of the cuticle.

Med. Uses. A powerful escharotic, destroying the tissues to a considerable extent; is deliquescent and unmanageable. May be neutralized by weak acids.

B. NITRATE.

*c. *POTASSÆ NITRAS—NITRATE OF POTASSA (*Nitre, Saltpetre*), (KO, NO_5).*

Prep. May be made by adding NO_5 to KO , or its carbonate. Exists in many caves, in the southwest portion of the United States, also, in India, Egypt, Peru, and many parts of Europe. Is formed artificially on the large scale in Nitre beds.

Prop. A white salt, occurring in elongated, anhydrous crystals, with dihedral summits; sharp, cooling taste; soluble in 7 pts. of water at 60° , and its weight of boiling water; fuses below a red heat, and at a higher heat is decomposed. Yields part of its O readily to heated surfaces: hence used in deflagrating mixtures, as gunpowder, and sometimes as a source of O.

Med. and Tox. Prop. In large doses $\frac{3}{ss}$ to $\frac{3}{j}$, an irritant poison: no direct antidote is known.

In medicinal doses, gr. $\frac{1}{10}$ to v., refrigerant, ? diaphoretic, and diuretic.

Paper is soaked in its solution, dried, and the products of its combustion inhaled, in asthma.

Used in large quantities, ȝj or ȝij in 24 hours, in divided doses, *largely diluted*, in acute rheumatism.

Incompat. Strong Sulphuric Acid.

c. CARBONATES.

d. *POTASSÆ CARBONAS IMPURUS—*Pearlash*, KO,
CO₂.

Prop. Obtained from the ashes of wood in *lixiviation*. It contains insoluble impurities, with Silicate and SULPHATE of Potassa and *Chloride of Potassium*. It is purified from these by mixing with an equal weight of cold water, allowing it to stand a day, stirring frequently, and filtering. The salts named, being less soluble than the KO₂CO₂, remain, with the mechanical impurities, in the filter. The solution is then evaporated, until it thickens, and stirred until it becomes granular. It is then the

e. *POTASSÆ CARBONAS—CARBONATE OF POTASSA.

Prop. Coarse, granular, white powder, of a nauseous, alkaline taste, and alkaline reaction; soluble in its own weight of water; very deliquescent. Is not entirely free from the impurities named above.

Med. Prop. Those of the alkalies generally.

Incompat. ACIDS, Acidulous salts, Muriate and Acetate of Ammonia, Lime-water, Chloride of Calcium, Sulphates of Magnesia and Alumina, Nitrate of Silver, Ammoniated Copper and Iron, Sulphate of Iron, Chlo-

ride of Iron, Calomel, Corrosive Sublimate, Acetate of Lead, Sulphate of Zinc.

*f. *LIQUOR POTASSÆ CARBONATIS—SOLUTION OF CARBONATE OF POTASSA.* R. *Potass. Carb.* lbj; *Aqua f* ʒ xii. *Solve et cola.*

*g. *POTASSÆ CARBONAS PURUS—Pure Carbonate of Potassa, Salt of Tartar.*

Is obtained by heating the *BICARBONATE OF POTASSA, by which one equivalent of CO_2 is driven off. The residue is dissolved, filtered, and evaporated.

Prop. Differs only from *Potass. Carb.* in being purer.

*h. *POTASSÆ BICARBONAS—BICARBONATE OF POTASSA—*Sal Aératus*, $\text{KO}_2\text{CO}_2 + \text{HO}_2\text{CO}_2$.* Made by passing a current of CO_2 through a solution of KO_2CO_2 , to saturation ; evaporation and crystallization.

Prop. Transparent, colourless, inodorous crystals ; alkaline, not acrid, taste ; slight alkaline reaction. Soluble in 4 pts. cold, and $\frac{1}{2}$ its weight of boiling water, which reduces it to *Sesquicarbonate*. Permanent in the air, decomposed by heat.

Med. Effects. Less irritating than the monocarbonate. Is used in the preparation of the “neutral mixture,” *LIQUOR POTASSÆ CITRATIS,* in which Oss of lemon-

* The salts of the organic acids will in general be introduced with their bases, in order to simplify the department of ORGANIC CHEMISTRY. The formula of Citric Acid is $3\text{HO}_2\text{C}_6\text{H}_5\text{O}_4$, the water being basic, and replaced in its combinations. It is therefore tribasic.

juice is neutralized with q. s. of the salt. Also to form the *POTASSE CITRAS : Acid. Citric. ʒx ; Potass. Bicarb. ʒxiv ; Aquæ q. s. ; mix, and after effervescence has ceased, evaporate to dryness.

Incompat. Those of KO₂CO₂.

D. SULPHIDE.

i. POTASSII SULPHURETUM—SULPHURET (Sulphide) *of POTASSIUM—Hepar Sulphuris, Liver of Sulphur.*

R. *Sulphur ʒj, Potass. Carb. ʒij.* Rub the S with the *Carbonate of Potassa*, previously dried, and melt the mixture in a covered crucible, over the fire. Then pour it out, and when cool, break into pieces, which preserve in a well-stopped bottle.

Rem. The CO₂ is expelled, and the reaction takes place between 10 eq. S, and 4 KO = KS₃ and KO₂SO₃. The preparation is therefore a mixture of *Tersulphide of Potassium* and *Sulphate of Potassa*.

Prop. Liver brown, brittle, solid ; inodorous when dry, fetid smell of HS when moist ; nauseous, bitter, alkaline taste ; completely soluble in water ; exposed to the air, absorbs O, and is converted into KO₂SO₃.

Med. and Tox. Prop. Large doses poisonous ; acts as a local irritant, and gives off HS, which is sedative, and reduces the action of the heart. Antidotes : SULPHATE OF ZINC, ACETATE OF LEAD.

In medicinal doses sedative and alterative.

Used principally externally, in solution, as a bath in skin diseases.

Incompat. The mineral acids ; the metals generally.

E. SULPHATE.

*k. *POTASSÆ SULPHAS—Sulphate of Potassa, KO₂SO₃.*

Prep. The direct union of its constituents. Is a secondary product in several chemical processes.

Prop. A white, anhydrous salt, in small, very hard, six-sided, prismatic crystals ; nauseous, somewhat bitter taste ; soluble in 10 parts cold, and 4 of boiling water.

Med. Effects. Mild purgative. If not dissolved, may, from the hardness of its crystals, produce symptoms of irritant poisoning. Used in *DOVER'S POWDER (*pulv. Ipecac. et Opii*), to divide and mix well the ingredients. Dose 3j to 3ss.

Incompat. Tartaric Acid, Salts of Baryta, Strontia, Lime, Silver, and Lead.

F. CHLORATE.

*l. *POTASSÆ CHLORAS—Chlorate of Potassa.*

Prep. By passing a current of CHLORINE gas into a strong solution of CAUSTIC POTASSA. A part of the KO is decomposed ; its O combines with Cl, to form ClO₅, which unites with another portion of KO, while the K

combines with another portion of Cl, to form KCl. 6 Cl, and 6 KO = 5 KCl and KO₂ClO₅.

Prop. Flat, tabular, anhydrous crystals, of a pearly lustre, cooling taste; soluble in 16 parts water, at 60°, and in 2½ of boiling water. Deflagrates on burning coals, and detonates with S, P, &c. Gives off all its O by heat, leaving KCl.

Med. Effects. Refrigerant and diuretic. Used in cancrum oris. (Hunt. Watson.)

Dose gr. x to xxx.

Incompat. The Mineral Acids, Tartaric Acid.

G. IODIDE.

m. POTASSII IODIDUM—*Iodide of Potassium*, KI.

R. *Potassa* ȝvi, *Iodinii* ȝxvi, *Carbo lig. pulv. subtil.* ȝij, *Aq. Bull. Oiji.*

The KO in solution, is treated by the I. IODIDE OF POTASSIUM and IODATE OF POTASSA are formed. 6 I and 6 KO = 5 KI and KO₂IO₅. The solution is evaporated, and by heat and stirring with the charcoal, the KO₂IO₅ is reduced to KI. The salt is then dissolved out and crystallized.

Prop. Generally in anhydrous cubic crystals, opaque white or transparent; soluble in ȝ of its weight of cold water, and in 6 or 8 parts cold alcohol; saline, cooling, disagreeable taste.

Impurities and Adulterations. BROMIDE of Potassium,

sometimes sold for the IODIDE, does not precipitate with *Corrosive Sublimate*. The most common impurities are, 1. *Chlorides*, which, with Nitrate of Silver, throw down a white precipitate, AgCl , freely soluble in Ammonia. KI throws down *Iodide of Silver*, Ag. I , which is scarcely soluble in Ammonia; 2. *Bromides*, which may be detected by removing all the I from the liquid by Sulphate of COPPER, and SO_2 , and testing for BROMINE. Iodate and Carbonate of Potassa may be detected by their insolubility in alcohol. If the *Iodide* should be very deliquescent, KO, CO_2 may be suspected.

Med. Effects. Those of Iodine generally. Used in slow poisoning by MERCURY and LEAD; which it is supposed to convert in the tissues into *Iodides*, which it afterwards dissolves. May thus render Mercury active, and produce salivation.

Dose, gr. v to xxx; has been given in $\frac{3}{ss}$ doses. Its ointment,

n. ***UNGUENTUM POTASSII IODIDI**, is made by rubbing up $\frac{3}{j}$ *Potass. Iodid.*, dissolved in $f\frac{3}{j}$ *Aqua*, with $\frac{3}{j}$ *Adipis*.

Incompatibles. Mineral Acids, Salts of Copper, Lead, Silver, Iron, Manganese; all the preparations of Mercury, except the Iodides—Tartaric Acid.

H. BROMIDE.

o. **POTASSII BROMIDUM**—*Bromide of Potassium*, K. Br.

R. *Bromin.* $\frac{3}{ij}$; *Ferri Ramenta* $\frac{3}{j}$; *Potass. Carb.*

$\frac{3}{2}$ ij, $\frac{3}{2}$ j, or q. s.; *Aq. Destill. Oiv.* The Bromine is combined with the iron filings, to form Bromide of IRON; which is then decomposed by the KO₂CO₂, FeBr, and KO₂CO₂ = FeO, CO₂ and KBr. The solution of KBr, is filtered from the insoluble *Carbonate of Iron*, and the salt crystallized out.

Prop. Resembles in appearance KI. Taste similar to common salt, but more acrid. Freely soluble in water; less so in alcohol.

Med. Effects. Those of KI, but less energetic. Dose, gr. iij to x, t. d. Used externally in ointment, $\frac{3}{2}$ j to $\frac{3}{2}$ ij, to $\frac{3}{2}$ j *Adipis.*

K. ORGANIC COMPOUNDS.

p. POTASSÆ ACETAS—ACETATE OF POTASSA, KO₂Ā,
or (C₄H₃O₃).

Prep. By saturating *ACETIC ACID with Carbonate of Potassa, and evaporating to dryness.

Prop. Foliated white crystalline mass, very deliquescent, of a warm, pungent, saline taste. Soluble in half its weight of water, and twice its weight of alcohol. Heated above point of fusion, decomposed into Acetone and KO₂CO₂.

Med. Effects. Diuretic; in larger doses, cathartic.

Incompat. The mineral acids, sulphate of soda and magnesia, corrosive sublimate, nitrate of silver; the aci-

dulous salts, and those of the metals proper, and earths generally.

q. POTASSÆ BITARTRAS—Bitartrate of Potassa. Acid Tartrate of Potassa, Cream of Tartar. $KO_2HO_2\bar{T}.$ *

Prep. From the deposit in wine casks, the *Argol*; by solution in hot water, and re-crystallization.

Prop. White, crystalline, permanent salt, slightly acid taste, acid reaction; soluble in 184 parts cold, and 18 boiling water; insoluble in alcohol. Is decomposed by a red heat, leaving carbonate of potassa, and charcoal. When in powder, liable to adulteration; but generally pure in crystals.

Chem. Rel. *TARTARIC ACID being bibasic, this salt consists of one eq. of acid, one of potassa, and one of water. By substituting for the latter, potassa, soda, the oxides of iron and antimony, a series of double salts is formed.

Med. Effects. Cathartic, diuretic, refrigerant.

Incompat. Solutions of Baryta, Strontia, Lime, Acetate of Lead; the concentrated mineral acids.

r. POTASSÆ TARTRAS—TARTRATE OF POTASSA—Soluble Tartar. $2KO_2\bar{T}.$

Prep. Made by adding to BITARTRATE OF POTASSA an eq. of CARBONATE OF POTASSA, and boiling. The

* The formula of Tartaric Acid, crystallized, is $2HO_2C_6H_4O_{10}$, the water being basic. Its symbol is \bar{T} .

CO_2 is given off, and two eqs. of neutral *Tartrate of Potassa* are formed. $\text{KO}_2\text{HO}\bar{T}$, and $\text{KO}_2\text{CO}_2 = 2\text{KO}_2\bar{T}$, and HO and CO_2 .

Prop. White, slightly deliquescent, anhydrous salt; soluble in two parts cold water, and less of boiling water. By heat melts, blackens, and is converted into KO_2CO_2 .

Med. Effects. Mild purgative.

Incompat. Those of the Bitartrate; the acidulous salts.

s, t. *POTASSÆ CITRAS, and *Liq. POTASSÆ CITRAS.
See *POTASSÆ BICARBONAS.

u. POTASSII FERROCYANURETUM—*Ferrocyanuret* (*Ferrocyanide*) of Potassium. $2\text{K}_2(\text{Fe}^{\text{3+}}\text{Cy})$.

Prop. Is made on the large scale, by calcining animal matters with carbonate of potassa, and adding iron. Has also been made by the action of a current of air upon a mixture of charcoal and carbonate of potassa, and iron. This process, although successful, was not economical, from the waste of potash.

Prop. Large, transparent, lemon-yellow crystals; inodorous; of a sweetish, saline taste. Soluble in about four parts of cold, and one of boiling water. Contains three eq. of water, when crystallized, which it loses at 126° . Forms characteristic precipitates when added to the salts of copper, zinc, and sesquioxide of iron.

Med. Effects. When pure, is not poisonous. Is considered sedative and astringent, but is seldom used.

Ferricyanide of Potassium. See Part III.

v. *POTASSII CYANURETUM—*Cyanuret (Cyanide) of Potassium, KCy.*

Prep. Is prepared by fusing together Ferrocyanide of Potassium (ʒ viii) and Carbonate of Potassa (ʒ iiij), until effervescence ceases.

Prop. White, opaque, amorphous masses; sharp, bitter, alkaline taste; alkaline reaction; is deliquescent; very soluble in water, and sparingly so in strong alcohol; is usually impure, containing principally Carbonate of Potassa, also Cyanate and Formate of Potassa. Decomposes slowly in the air, Hydrocyanic Acid being disengaged, and Carbonate of Potassa formed.

Med. Effects. Those of Hydrocyanic Acid, which is liberated by the addition of acids. When an excess of Tartaric Acid is added, the Acid Tartrate of Potassa falls, leaving Hydrocyanic Acid in solution. From its variable strength is uncertain. Dose, gr. $\frac{1}{8}$ th.

Incompatibles. All Acids, and Acid Salts, Nitrate of Silver.

XIV. SODIUM (NATRIUM). Na. 22.97.

Prep. Obtained by reducing Soda by charcoal, at a high heat.

Prop. Resembles, in all its properties, *Potassium*; is soft, silvery, easily tarnished; Sp. Gr. 0.972; liquid at 1.94; decomposes water, but does not take fire, unless the

water be warm, or the metal be prevented from moving about.

Abundant in all *animal* forms, as Potassa is in the vegetable; forms with O, NaO, SODA, NaO₂, Binoxide of Na, and perhaps NaO₃, Teroxide. All the compounds of Sodium resemble strongly those of Potassium.

A. SODA, NaO.

Made by oxidizing Na. The Hydrate, CAUSTIC SODA, is made by boiling Carbonate of Soda, and Caustic Lime. See POTASSA. Resembles Caustic POTASSA.

Chem. Rel. A powerful base; forms an extensive series of salts, all of which are soluble.

The CHLORIDE OF SODIUM, CHLORINATED SODA, and the NITRATE, CARBONATES, SULPHATE, PHOSPHATE, ACETATE, and TARTRATE, are officinal.

Test. The yellow colour its salts communicate to the flame of the blowpipe.

Incompatibles. Those of KO, except the Neutral Tartrates.

B. CARBONATES.

a. *SODÆ CARBONAS—CARBONATE OF SODA, NaO, CO₂.

Prep. Is obtained from BARILLA, the ashes of plants growing by the sea-side, but more generally by the decomposition of SULPHATE OF SODA. This salt is heated

in a reverberatory furnace, with limestone (CaO, CO_2), and coarse coal (C). The Carbon deoxidizes the NaO, SO_3 , leaving *Sulphide of Sodium*. NaO, SO_3 and $4 \text{C} = \text{NaS}$, and 4CO . The Sulphide of Sodium reacts with the Carbonate of Lime to form *Sulphide of Calcium*, and CARBONATE OF SODA, NaS , and $\text{CaO}, \text{CO}_2 = \text{NaO}, \text{CO}_2$ and CaS . The Carbonate of Soda is obtained from the mixture by solution and crystallization.

Prop. A colourless salt, crystallizing in large, oblique, rhombic prisms, which effloresce. They contain about 60 p. c. of water. Taste alkaline and disagreeable, soluble in 2 parts cold water; reaction alkaline; heated loses its water, and afterwards fuses; may contain a small quantity of common salt, Sulphate of Soda, or Sulphide of Potassium, as impurities; but they are not in sufficient quantity to be injurious for ordinary purposes.

Med. Effects and Incompat. Those of CARBONATE OF POTASSA.

Dose, gr. x to 3ss; in large quantities an irritant poison. Antidotes: vinegar, lemon juice, fixed oils.

*b. *SODÆ CARBONAS EXSICCATUS—DRIED CARBONATE OF SODA.*

Is made by drying the crystallized carbonate; from its containing less water must be given in smaller doses; is convenient for making into pills.

*c. *SODÆ BICARBONAS—BICARBONATE OF SODA—*Super Carbonate of Soda*, HO, CO_2 , NaO, CO_2 .*

Prep. By saturating NaO_2CO_2 with CO_2 . The operation is best performed by placing the crystals of the salt in a porous diaphragm in a box, and passing the gas over them. As the Bicarbonate contains less water than the Carbonate, the excess falls through the perforations during the process.

Prop. A white powder; alkaline, not acrid taste; alkaline reaction; soluble in 13 parts cold water; in boiling water loses a portion of CO_2 , and becomes *Sesquicarbonate*.

Med. Properties. The mildest and least disagreeable of the alkaline preparations. Employed in the same cases as the alkalies generally. Also in *Soda* and *SEIDLITZ POWDERS*.

c. SULPHATE.

d. SODÆ SULPHAS—SULPHATE OF SODA—Glauber's Salt, NaO_2SO_3 .

Prep. Made by the action of SO_3 on the weaker salts of Soda.

Prop. Recently prepared is in long prismatic crystals; cooling and bitter taste; containing 10 eq. water, or nearly 76 per cent., in which they fuse readily, and lose entirely, by efflorescence in dry air at common temperatures. The anhydrous salt is soluble in 5 parts water at 60° , and 2 parts at 91° , which is its temperature of maximum solubility.

Med. Prop. Cathartic. Not now much used.

Incompat. Those of the soluble salts of *Sulphuric Acid.*

D. PHOSPHATES.

Soda forms with PO_5 in common with other bases, three distinct salts, each containing one eq. of acid, but having respectively one, two, and three eqs. of base. They are the Metaphosphate of Soda, NaO,PO_5 , made by heating acid Phosphate of Soda to redness ; Pyrophosphate of Soda, 2NaO,PO_5 , made by heating the common PHOSPHATE OF SODA to redness ; and Common PHOSPHATE OF SODA, $\text{HO,2NaO,PO}_5 + 24\text{HO}$, made by adding CARBONATE OF SODA to the *Superphosphate of Lime*, obtained by adding SO_3 to calcined bones. The Lime is converted into Carbonate, while the PO_5 unites with the NaO. This is the officinal salt. We have also the Subphosphate of Soda, 3NaO,PO_5 , acid Phosphate of Soda, 2HO,NaO,PO_5 , 2HO , and Bipyrophosphate of Soda, HO,NaO,PO_5 .

e. *SODÆ PHOSPHAS—PHOSPHATE OF SODA.—*Tasteless, purging salt, HO,2NaO,PO₅.*

Prep. Given above.

Prop. Large, transparent, colourless crystals, speedily efflorescing, and becoming opaque ; taste resembles common salt ; reaction alkaline ; soluble in 4 parts cold, 2 boiling water ; gently heated, loses water of crystallization ; at a red heat, loses its *basic* water, and becomes

pyrophosphate; contains 24 equiv. of water of crystallization.

Med. Effects. Mild cathartic.

Dose $\frac{3}{4}$ j to $\frac{3}{4}$ ij.

Incompat. Soluble Salts of Lime; neutral metallic solutions; strong acids.

E. CHLORIDE. NaCl.

*f. *SODII CHLORIDUM—Chloride of Sodium, Common Salt, NaCl.*

Prep. Is obtained from sea-water, salt springs, or salt mines (rock salt), in which it exists native. Sea-water or that of salt springs is evaporated, until the greater part of the NaCl crystallizes out; the mother liquid, holding in solution the more soluble salts, as the Chlorides of Magnesium, the Sulphate of Soda, &c., is drawn off, constituting *bittern*.

Prop. An anhydrous salt, crystallizing in cubes; of a well-known, agreeable taste; when pure, does not alter in the air; soluble in about 3 parts water; the solubility is not much increased by heat.

Impurities. Insoluble matters, Chlorides of Lime and Magnesium, Sulphates of Soda and Lime.

Med. Effects. Small doses, tonic, anthelmintic; large, emetic and purgative. Is the antidote to NITRATE OF SILVER.

Incompat. Strong Sulphuric Acid, Nitrate of Silver, Sulphates of Copper and Iron, Protoxide of Mercury.

*g. *LIQUOR SODÆ CHLORINATÆ—SOLUTION OF CHLORINATED SODA—Labarraque's Disinfecting Liquid.* NaO, ClO , and NaCl ?

Prep. R. *Calcis Chlorinat.* Ibj; *Sodæ Carb.* Ibj; *Aq. Cong.* jss. Dissolve the Carbonate of Soda in Oij of the *Aq.*, with the aid of heat; to the remainder of the *Aq.* add the *Calc. Chlorin.* by small portions, stirring after each addition; allow the solution to stand, that impurities may subside; pour off the clear liquor and mix with the solution of *Sodæ Carb.*; allow the precipitate of Carbonate of Lime to subside; pass the clear liquid through a linen cloth, and keep in well-stopped bottles, secluded from the light.

Rem. This process consists in decomposing a solution of **CHLORINATED LIME* by *Carbonate of Soda*; *Carbonate of Lime* and *Chlorinated Soda* result. The constitution of this solution is uncertain (see **CHLORINATED LIME*). It may be either *Hypochlorite of Soda*, with *Chloride of Sodium*, or, according to Millon, contains an *Oxychloride* of Sodium, $\text{Na}_2 \left\{ \begin{matrix} \text{O}_2 \\ \text{Cl}, \end{matrix} \right.$ or $2 \text{NaO}, \text{Cl}$.

Prop. A colourless liquid; faint odour of Chlorine, alkaline reaction.

Med. Uses. Those of *Chlorine*, upon which it depends for its effects. It is the most elegant and manageable of

the Chlorine compounds for prescription or use on the small scale.

Dose, gtt. xxx. to fʒj, diluted.

Incompat. Acids, Nitrate of Silver.

With IODINE and BROMINE, sodium forms salts analogous to those of Potassium. They are sometimes employed in medicine.

F. BORATE.

h. SODÆ BORAS—BORAX, $\text{NaO}_2 \cdot 2 \text{BO}_3$.

Prep. Occurs native and is made by the addition of native Boracic Acid, BO_3 , to Soda.

Prop. A white, crystalline salt, soluble in 12 parts cold and 2 of boiling water; taste, sweetish alkaline; reaction, alkaline; exposed to the air, effloresces; contains ordinarily 10 eqs. water of crystallization, in which it fuses at a moderate heat; at a higher heat, loses its water of crystallization and fuses, forming, when cool, *glass of Borax*. Is a Biborate of Soda.

Med. Effects. Refrigerant and diuretic. Generally used, rubbed up with sugar and honey, as a mild astringent in aphthous sore mouth of children.

G. ORGANIC COMPOUNDS.

i. SODÆ ACETAS—*Acetate of Soda*, $\text{NaO}_2 \cdot \text{C}_2\text{H}_4\text{O}_2$.

Prep. Is made by saturating Acetic Acid with Carbonate of Soda.

Prop. White salt, crystallized in long, striated prisms; effloresces slowly in dry air; contains 6 eq. water, when crystallized; soluble in 3 parts cold water, and 24 of alcohol; heated, melts in its water of crystallization, which is then driven off, and the salt undergoes igneous fusion, and is finally decomposed, the residue being a mixture of NaO, CO₂, and C.

Med. Effects. Those generally of Acetate of Potassa.

k. SODÆ ET POTASSÆ TARTRAS—TARTRATE OF POTASSA AND SODA—Rochelle Salt, KO₂NaO₂T.

Is made by saturating a boiling solution of BITARTRATE OF POTASSA with CARBONATE OF SODA, KO₂HO₂T, and NaO₂CO₂ = KO₂NaO₂T, and CO₂, and HO.

Prop. Large, transparent, prismatic crystals, efflorescing in the air; the crystalline salt contains 10 eq. water; dissolves in 5 parts cold, and 1½ boiling water; taste mild saline; reaction neutral.

Med. Effects. The least nauseous of the saline cathartics; the active ingredient of *Seidlitz Powders*. These are composed of gr. xxv Acid. Tartaric., put up in a white paper, and 3ij Sodæ et Potass. Tart., with 3ij Sodæ Bicarb., mixed, and put up in the blue paper. When the contents of these are separately dissolved, and the solutions mixed, effervescence takes place, owing to the escape of the CO₂ of the KO₂CO₂, while the KO unites with the T, to form an additional eq. of Tartrate of Soda.

Incompat. Acids, Acidulous Salts, Salts of the Alkaline Earths.

XV. AMMONIUM. NH_4 . 18. (Hypothetical.)

When a globule of mercury is placed on a piece of moistened *Sal Ammoniac*, and submitted to the action of a powerful voltaic battery, an *amalgam* is formed. It may also be procured by immersing an amalgam of Potassium and Mercury in a strong solution of *Sal Ammoniac*. The mass swells to many times its original bulk, and becomes pasty. Left to itself, it quickly decomposes into Mercury, Ammonia, and Hydrogen.

The amalgam thus formed, is supposed to be constituted of Mercury, and an hypothetical substance, *Ammonium*, which, although composed of Nitrogen and Hydrogen, acts in all its chemical relations as an elementary body. Its compounds resemble strongly those of Potassium and Sodium. All attempts to isolate it have failed. Its oxide is **AMMONIA**, NH_4O (NH_3).

A. AMMONIA, NH_4O (NH_3).

Prop. Made by heating a mixture of CHLORIDE OF AMMONIUM (Muriate of Ammonia, *Sal Ammoniac*), with Quicklime, AMMONIA is given off, and CHLORIDE OF CALCIUM remains. $\text{NH}_4\text{Cl} + \text{CaO} = \text{NH}_4\text{O} + \text{CaCl}$.

Prop. A colourless, transparent gas, taste hot and acrid, odour pungent and suffocating; is irrespirable; Sp.

Gr. 0·59 ; is slightly inflammable ; by cold and pressure, is condensed into a transparent, colourless liquid, Sp. Gr. 0·731 ; cold water dissolves about 670 vols. of this gas, and the solution, which increases in bulk about two-thirds, is specifically lighter than pure water.

Gen. Chem. Rel. Is a powerful alkali, having the alkaline reaction, and combining with acids to form salts, which bear a striking general resemblance to those of Potassa and Soda. From the volatile nature of the base, they are decomposed or volatilized by a high heat. They are all colourless when pure, and soluble. They may be recognized by the evolution of Ammonia, when treated with Hydrate of Lime.

Officinal Forms.

a. LIQUOR AMMONIÆ FORTIOR—Stronger Solution of Ammonia.

Prep. By passing Ammonia into water kept cold.

Prop. A colourless liquid, of a caustic acrid taste, and very pungent smell ; Sp. Gr. 0·875 at 50° ; gelatinizes at 40°, and boils at 130°, liberating Ammonia ; it contains 32·5 p. c. of Ammonia.

Med. Effects. Is too strong for medical use ; is used to form other preparations of Ammonia.

Incompat. Acids, Acidulous Salts, the neutral salts of the metals generally, Chlorine.

*b. *LIQUOR AMMONIÆ—Solution of Ammonia.*

Is the term applied to an aqueous solution of Ammonia, of Sp. Gr. 0·960, containing about 10 per cent.

Med. Effects. Stimulant, diaphoretic, antacid; used in cases of bites of serpents, stings of insects, &c., both internally and applied to the wound; externally is rubefacient and vesicant; in over dose, an irritant poison,—antidote, weak acids. Dose, gtt. x to xxx.

c. *SPIRITUS AMMONIÆ—SPIRIT OF AMMONIA—*Spirit of Hartshorn.*

Prep. By passing Ammoniacal Gas into *ALCOHOL.

Prop. Colourless, transparent liquid; taste acrid and caustic; odour strongly ammoniacal; Sp. Gr. about 0·831, being about the strength of the *LIQ. AMMONIÆ. Dose, gtt. x to xxx.

d. *SPIRITUS AMMONIÆ AROMATICUS—AROMATIC SPIRIT OF AMMONIA—*Aromatic Spirit of Hartshorn.*

R. *Ammon. Mur.* ʒv; *Potass. Carb.* ʒviii; *Cinnam. Contus. Caryophyll.* *Contus.* aā ʒij; *Cort. Limon.* ʒiv; *Alcohol, Aque,* aā Ov. M. and distil Oviiss.

Rem. The *Muriate of Ammonia* (Chloride of Ammonium) and *Carbonate of Potassa* react, to form Carbonate of Ammonia, and Chloride of Potassium. $\text{NH}_4\text{Cl} + \text{KO}_2 = \text{NH}_4\text{O}_2\text{CO}_2 + \text{KCl}$. The preparation is therefore a solution of Carbonate of Ammonia, impregnated with the oils of Cinnamon, Cloves, and Lemon. Sp. Gr. 0·918.

Dose, gtt. x to xxx.

e. *LINIMENTUM AMMONIÆ—LINIMENT OF AMMONIA.

Volatile Liniment.

R. *Liq. Ammoniæ fñi; Ol. Olivæ fñij.* M.

The solution of Ammonia forms, with the oil, a soap. Is much used as a mild rubefacient.

B. CARBONATES.

f. *AMMONIÆ CARBONAS—*Carbonate of Ammonia,*
 $2\text{NH}_4\text{O}, 3\text{CO}_2$.

Prep. Is made by subliming a mixture of Muriate of Ammonia (Chloride of Ammonium), and Chalk (Carbonate of Lime), $3\text{NH}_4\text{Cl}$, and $3\text{CaO}, \text{CO}_2 = 2\text{NH}_4\text{O}, 3\text{CO}_2$, and 3CaCl and NH_4O .

Prop. White, moderately hard, translucent masses; soluble in four parts cold water, and in diluted alcohol; is decomposed by boiling water. Smell pungent, ammoniacal; taste sharp, alkaline. Exposed to the air, it disengages neutral carbonate of ammonia ($\text{NH}_4\text{O}, \text{CO}_2$), and becomes *Bicarbonate* ($2\text{NH}_4\text{O}, 3\text{CO}_2 - \text{NH}_4\text{CO}_2 = \text{NH}_4\text{O}, 2\text{CO}_2$). The Bicarbonate is inodorous, fixed; its crystals resemble those of Bicarbonate of Potassa.

Med. Effects. A mild preparation, possessing the therapeutical properties of ammonia. Dose, gr. v.

Incompatibles. Those of the soluble carbonates, and of Ammonia.

With c, HYDROSULPHURIC ACID, HS, Ammonia forms the HYDROSULPHATE OF AMMONIA; or more properly,

the *Hydrosulphate of the Sulphide of Ammonium*, $\text{NH}_4\text{S} + \text{HS}$. This is made by passing HS into Liq. Ammonia to saturation. It is nearly colourless at first, but slowly becomes yellow. It is of great value as a test for the metals. Has been used in Medicine, in cases where HYDROSULPHURIC acid is indicated; and possesses, in addition, the effects of *Ammonia*. It is an exceedingly useful application, externally in rheumatism and gout.

D. CHLORIDE.

g. *AMMONIÆ MURIAS—MURIATE OF AMMONIA (Chloride of Ammonium)—*Sal Ammoniac*, NH_3KCl , or NH_4Cl .

Prep. On the large scale, from organic matters containing Ammonia—as gas liquor, bone spirit, putrid urine, soot, coal, and guano. The various compounds of ammonia in these are generally converted into sulphate by the addition of SO_3 . This is sublimed with common salt, giving sulphate of soda, and chloride of ammonium. $\text{NH}_4\text{O}_\text{SO}_3$, and $\text{NaCl} = \text{NaO}_\text{SO}_3$, and NH_4Cl .

Prop. White, inodorous, translucent, fibrous salt; taste pungent, saline. Soluble in three parts cold, and one boiling water; less so in ordinary alcohol. Sublimes unchanged at a red heat; very difficult to powder. It may be granulated by evaporating its solution, and constantly stirring as the mass thickens. Reaction slightly acid.

Med. Effects. Alterative; in large doses, purgative. Externally, in bruises, tumours, &c. Dose, gr. v to xxx.

Incompat. Those of the soluble chlorides, and of ammonia.

E. ACETATE.

*h. LIQUOR AMMONIAE ACETATIS—SOLUTION OF ACETATE OF AMMONIA—*Spirit of Mindererus*, $\text{NH}_4\text{O}, \bar{A}$.*

Prep. By saturating *DILUTED ACETIC ACID with carbonate of ammonia.

Prop. Colourless, inodorous liquid, saline taste. Speedily decomposes.

Med. Effects. Diaphoretic, or diuretic; used in intoxication. Externally, as a cooling alterative lotion in skin diseases. Dose, fʒss to fʒj.

Incompat. Alkalies, alkaline earths, lime-water; those of the soluble acetates, and of ammonia generally.

METALS OF THE ALKALINE EARTHS.

XVI. BARIUM. Ba. 68·84.

Prep. By passing the vapour of K over BARYTA.

Prop. White metal, resembling silver; fusible below a red heat; sinks in oil of vitriol; decomposes water with avidity, forming BaO.

Chem. Rel. Forms two oxides; BARYTA, BaO, and Binoxide, BaO₂. Also compounds with the other non-metallic elements.

A. BARYTA. BaO.

Prep. Heat NITRATE of Baryta, to bright redness.

Prop. A gray powder; Sp. Gr. 4; slakes like lime, forming a *hydrate*; absorbs carbonic acid greedily; is caustic.

Chem. Rel. Forms a series of permanent salts, of which the CHLORIDE only is used in medicine. The soluble salts of Baryta are incompatible with the soluble sulphates, oxalates, and tartrates.

Tests. The soluble salts of BaO, give a white precipitate with SO₃, unaltered by NO₃, or HCl. They are all *poisonous*. ANTIDOTE, the soluble SULPHATES.

Officinal Preparations. *a.* *BARII CHLORIDUM—*Chloride of Barium.* BaCl.

Prep. By neutralizing HCl with BaO, CO₂. On the large scale, by decomposing the native SULPHATE (Heavy Spar), by heating with Carbon (see CARBONATE OF SODA); the Sulphide of Barium formed is decomposed, by the addition of HCl, into BaCl, and HS.

Prop. Permanent white crystalline salt; taste bitter and disagreeable; contains 2 eqs. water of crystallization, which it loses with decrepitation below 212°. Soluble in 2½ parts cold water, and its weight at 222°, the boiling-point of a saturated solution; also in diluted alcohol, but scarcely in absolute alcohol. Alcohol containing it, burns with a yellow flame. Fuses at a red heat.

Med. Effects. Large doses, poisonous (see BARYTA);

moderate doses, alterative and anthelmintic. Used in carcinoma, scrofula, cutaneous diseases. Given generally in solution.

b. *LIQUOR BARII CHLORIDI—*Solution of Chloride of Barium.* R. *Barii Chlorid.* ʒj; *Aq. destill.* f ʒiij. M. et cola. Dose, gtt. v; gradually increased.

Incompat. Those of the soluble Chlorides, and *Salts of Baryta.*

XVII. STRONTIUM. Sr. 43·84.

Prep. In same manner as Ba, which it closely resembles.

Rem. Forms STRONTIA, SrO, and Binoxide of Strontium, SrO₂. The former gives a series of salts, which give a red tinge to flame. They precipitate with the soluble sulphates, but less completely than BaO. May be distinguished by Hydrofluosilicic Acid, which precipitates BaO, but forms a salt with SrO, very soluble in excess of acid. The preparations are *not* poisonous, and have been used in medicine with the same objects as those of Ba.

XVIII. CALCIUM. Ca. 20.

Prep. By means analogous to those of Ba, and Sr. Is a white metal, very easily oxidized; forms CaO, Lime, and CaO₂, Binoxide of Calcium. The former only forms salts.

*a. *CALX, Lime, CaO.*

Prop. By heating, in an open furnace, the *Carbonate* (limestone, chalk, &c.).

Prop. Grayish-white, solid ; taste, caustic, alkaline. Sp. Gr. 2·3, very refractory. Absorbs on exposure to the air, water and CO₂, and falls to powder (air-slaked lime) ; combines with water, to form a hydrate (slaked lime). When mixed in excess with water, forms *milk of lime*. Is sparingly soluble in water, and more so in *cold* than in *hot* water. Reaction, alkaline ; is a strong base ; is caustic. The Chloride, the Carbonates and the Chlorinated Lime, are officinal.

Incompatibles. Acids, acidulous salts, soluble sulphates, tartrates, carbonates ; the metallic salts generally ; the vegetable astringents. Is the *antidote* to OXALIC ACID.

Test. Oxalic acid, gives a white precipitate in neutral or alkaline solutions.

*b. *LIQUOR CALCIS—Lime Water.*

R. *Calcis* ȝiv; *Aq. Destill.* Cong. j. Slake the Lime with a little of the water, then pour on the rest. Keep in well-stopped bottles over the insoluble excess of lime.

Rem. Water at 60° dissolves about $7\frac{1}{2}$ grs. of Lime ; one pint contains, at 60°, about 9½ grs. ; heated, a portion of the Lime precipitates ; the solution absorbs Carbonic Acid readily, and an insoluble carbonate precipitates.

Med. Effects. Antacid, and the compounds formed by

its union with the gastric acids, are *astringent*. Used in Diarrhoea, Vomiting, Dyspepsia, &c.; externally as an astringent lotion. Dose, fzss to $\frac{3}{4}$ iv.

Incompat. Those of Lime.

c. *POTASSA CUM CALCE—*Potassa with Lime*—Vienna Paste.

Prep. Is made by rubbing together equal parts of LIME and *Hydrate of Potassa*; is deliquescent, but less so than the Caustic Potassa; is employed in the same cases, and is a milder application.

B. CARBONATES.

Carbonate of Lime occurs native as Chalk, Marble, Limestone, &c.; is obtained by precipitating Chloride of Calcium with a soluble carbonate.

d. *CALSIS CARBONAS PRÆCIPITATUS—*Precipitated Carbonate of Lime*.

R. *Liq. Calcii. Chlorid.* Ovss; *Sodæ Carb.* lb.vi; *Aq. Destill.* q. s. Dissolve the *Sodæ Carb.* in *Ovi Aq.*; heat this solution, and that of the *Calcii. Chlorid.*, to the boiling-point, and mix them; allow the Carbonate to subside, wash it well, and dry on bibulous paper; this reaction is a double decomposition, Chloride of Sodium and Carbonate of Lime being formed. ($\text{CaCl} + \text{NaO}_\text{CO}_2 = \text{CaO}_\text{CO}_2 + \text{NaCl}$)

Prop. An insoluble white powder, smooth, and entirely dissolved with copious effervescence in Muriatic Acid.

May be adulterated with CaO_2SO_3 , which is detected by thus treating it.

e. *CRETA PRÆPARATA—*Prepared Chalk.*

Prep. Is made by the *levigation* and *elutriation* of ordinary Chalk, by which the grosser and gritty particles are gotten rid of; generally prepared on the large scale.

Prop. Found in conical masses, smooth, and entirely free from grit.

Med. Effects. Those of Lime; externally as a desiccating and soothing application. *Dose*, gr. x to xxx.

f. *TESTA PRÆPARATA—*Prepared Oyster-Shells.*

Prep. Is made by preparing well-washed oyster-shells in the same manner as chalk; does not differ from *Creta Præparata*, except in containing a little animal matter.

c. CHLORIDES.

g. *CALCII CHLORIDUM—*Chloride of Calcium.* CaCl .

Prep. Is made by dissolving Carbonate of Lime in Hydrochloric Acid. CaO_2CO_3 and $\text{HCl} = \text{CaCl}$, and HO and CO_2 .

Prop. When anhydrous is a whitish, hard, translucent substance, having a great attraction for moisture; hence used largely as a desiccating agent, when crystallized in frigorific mixtures; taste acrid, bitter; reaction slightly alkaline; soluble in about $\frac{1}{15}$ its weight of water, at 60° ; also in 10 parts anhydrous Alcohol.

Incompat. Those of the Salts of Lime, and of Hydrochloric Acid.

Med. Effects. Tonic and alterative; used in solution.

*h. *LIQUOR CALCII CHLORIDI—Solution of Chloride of Calcium.*

Prep. Made by dissolving Chloride of Calcium in its weight and a half of water, and filtering.

Dose. Gtt. xxx to 3j; in overdose, may produce symptoms of irritant poisoning; *antidotes*, the carbonates or sulphates.

*i. *CALX CHLORINATA—CHLORINATED LIME—Bleaching Powder—Chloride of Lime.* $\text{CaO}, \text{ClO} + \text{CaCl}$.

Prep. Made by the action of Cl on HO,CaO; should contain at least 25 per cent. of Chlorine.

Prop. Grayish-white powder; taste hot, acrid, bitter, and astringent; smell characteristic; bleaches powerfully; speedily loses its chlorine when kept; is decomposed on exposure to the air, absorbing CO₂, which liberates Cl; the same effect is produced by acids generally; soluble in 10 parts water; heated gives off O and some Cl, and becomes CaCl; its composition is uncertain, supposed to be: 1. Mixture of Hypochlorite of Lime, and Chloride of Calcium; 2. Chloride of Lime; 3. Oxychloride of Calcium.

Med. Effects. Not much used internally, the *CHLORINATED SODA being preferred; used largely as a disinfectant, and as a wash in foul ulcers; acts by the liberation of its Chlorine.

Incompat. Acids and Acidulous Salts, the Carbonates; the neutral Metallic Salts; those of Chlorine and Lime generally.

D. SULPHATE. CaO_2SO_3 .

Gypsum, Plaster of Paris, is found native. Is soluble in about 400 parts water, causing permanent hardness; when anhydrous (Calcined Plaster), it forms, with water, a hydrate, which quickly hardens (sets); hence is largely used in taking casts; heated above 300° , refuses to unite again with water; is not used in medicine.

The **E. Phosphate of Lime**, is used in medicine, officinal in Dub. Ph., in the form of *Bone Phosphate of Lime*; it consists of $3 \text{CaO}_2\text{PO}_5$; is insoluble; used in Scrofula, Phthisis, &c.

XIX. MAGNESIUM. Mg. 12·67.

Prep. By the reaction at a high heat of Sodium, with Chloride of Magnesium.

Prop. White, malleable metal, fusible at a red heat; not acted on sensibly by cold water; oxidized by hot water; heated in the air, burns and forms **MAGNESIA**, MnO , which is its only oxide.

A. *MAGNESIA, MnO , Calcined Magnesia.

Prep. Made by heating CARBONATE OF MAGNESIA to a full red heat, in an open crucible; the Carbonate loses its Carbonic Acid and water, and anhydrous MAGNESIA

remains; may be precipitated as hydrate by the action of Caustic Alkali on its SULPHATE.

Prop. A nearly insoluble, light, white bulky powder, nearly insipid, fused only by the compound blowpipe; it should not effervesce with acids. *Dense Magnesia* (Henry's, Husband's, &c.) is from $\frac{1}{3}$ to $\frac{1}{4}$ the bulk of ordinary Magnesia, and is less rough to the taste; it may be produced, 1. By trituration; 2. By using a high heat during calcination; 3. By packing the Carbonate closely in the crucible before heating; 4. By heating the Carbonate, prepared by mixing hot concentrated solutions of *SULPHATE OF MAGNESIA and Carbonate of Soda (Burr); 5. By heating Chloride of Magnesium.

Impurities. May contain CO_2 , when it will effervesce with Acids; CaO , which will precipitate on the addition of Oxalate of Ammonia; or soluble Sulphates, which will precipitate on the addition of Chloride of Barium.

Chem. Rel. With water, forms a hydrate, without elevation of temperature; slowly attracts moisture and CO_2 from the air; reaction alkaline, and neutralizes acids; the Carbonate, Sulphate, and Citrate are officinal.

Tests. It precipitates from its salts as hydrate, by the Caustic Alkalies, and as Carbonate, by their Carbonates; not with Carbonate of Ammonia, or the Bicarbonates; a white crystalline precipitate with the soluble Phosphates, on the addition of a little Ammonia.

Med. Effects. Antacid; the salts formed are laxative;

from its low eq., has a high neutralizing power. The freshly prepared Hydrate is an *antidote* to *ARSENIOUS ACID.

Incompat. All Acids and Acidulous Salts. Neutral Metallic Salts.

B. CARBONATES.

b. *MAGNESIAE CARBONAS—*Carbonate of Magnesia.* Magnesia Alba.

Prep. On the large scale by double decomposition of SULPHATE OF MAGNESIA and Carbonate of Soda, Carbonate of Magnesia and Sulphate of Soda resulting, MnO , SO_3 and $NaO\text{CO}_2 = Mn\text{OCO}_2$, and $NaO_2\text{SO}_3$. Its composition is not constant, being a mixture of Carbonate and Hydrate of Magnesia, $4(\text{MgO}, \text{CO}_2) + \text{MgO}, \text{HO} + 6\text{HO}$.

Prop. White; nearly insoluble; smooth; nearly insipid; inodorous; solid; generally formed in small cubes; it is soluble to a certain extent in *Aqua. Acid. Carbonici*, forming the so-called *Fluid Magnesia*. It is decomposed by heat.

Impurities. May contain Carbonate or Sulphate of Soda; Chloride of Sodium, Lime, Alumina, Iron; which may be detected by their respective tests.

Med. Effects. Those of *MAGNESIA. The Carbonic Acid is liberated in the stomach, producing at times an agreeable stimulation, at others unpleasant eructations.

Incompat. Those of MgO and of the Carbonates. The

Acids, and Acidulous Salts, Neutral Salts of the metals.
The Alkalies, Baryta, Strontia.

c. SULPHATE.

c. *MAGNESIÆ SULPHAS—*Sulphate of Magnesia, Epsom Salt, MgO,SO₄.*

Prep. Occurs native in certain caverns in the United States, and as an efflorescence in the soil. Also in certain springs, and in sea-water (*Bittern*), from which it is prepared by evaporation and careful crystallization. Made also of the native *Dolomite* (Carbonate of Lime and Magnesia), and from the native Silicious Hydrate.

Prop. Transparent, inodorous, bitter, nauseous, neutral salt; crystallized in small prisms, containing 7 eq. of water of crystallization; soluble in an equal weight of water at 60°; melt in their own water of crystallization, which they lose at a high heat, and fuse into an enamel.

Impurities. Iron and Chloride of Magnesium.

Med. Effects. Mild cathartic. Dose, ʒss to ʒi.

Incompatibles. Those of the soluble Sulphates; the Alkalies, and Earths, and their Carbonates.

With Citric Acid (C₁₂H₅O₁₁), Magnesia forms a Citrate, 3 MgO (C₁₂H₅O₁₁), which is officinal as :—

*LIQUOR MAGNESIÆ CITRATIS—*Solution of Citrate of Magnesia.* Purgative Mineral Water.

R. *Magnesiae Carb.* 3ii; *Acid. Citric.* 3viiss; *Syrup.*

Acid. Citric. f $\ddot{\Sigma}$ ij. ; *Aqua q. s.* Dissolve the *Acid. Citric.* in f $\ddot{\Sigma}$ iv *Aq.*, and add $\ddot{\Sigma}$ iv *Magnes. Carb.*, previously rubbed with f $\ddot{\Sigma}$ iii *Aqua*. When reaction has ceased, filter into a strong glass bottle of the capacity of f $\ddot{\Sigma}$ xii, into which the *Syr. Acid. Citric.* has been previously introduced. Rub the remaining *Magnes. Carb.* with f $\ddot{\Sigma}$ ii *Aq.*, and pour into the bottles; cork tightly, secure with twine, and shake until clear.

Rem. This solution is intended to be made extemporaneously, and does not keep well. It may be made more permanent by an excess of Citric Acid.

Med. Effects. An agreeable purgative, resembling lemonade, charged with Carbonic Acid. Dose, f $\ddot{\Sigma}$ vi to xii.

METALS OF THE EARTHS.

XX. ALUMINUM. Al. 13·69.

Prep. By passing the vapour of K or Na over Chloride of Aluminum, Al_2Cl_3 .

Prop. A brilliant metal, resembling silver; not oxidized by air, water, or acids, except boiling nitric acid.

Chem. Rel. Forms a Sesquioxide ALUMINA, of which the SULPHATE united with the Sulphate of Potassa is officinal, as *ALUMEN—Alum. It is precipitated from its salts by the caustic alkalies as a gelatinous mass. Exists in clay.

A. *ALUMEN—*Alum*, $\text{Al}_2\text{O}_3 \cdot 3\text{SO}_3 + \text{KO}_2\text{SO}_3$.

Prep. Is found native; made in several ways: 1. From the alum-stone, a native Alum, combined with Hydrate of Alumina; the latter is rendered insoluble by heat, and the Alum dissolved out. 2. From Aluminous Schist, which consists of a mixture of Iron Pyrites, FeS_2 , Alumina, Silica, &c.; by heating and moistening, Oxygen is absorbed, the Sulphur converted into Sulphuric Acid, which combines with the Alumina, and Oxide of Iron. The two are separated by crystallization, and Sulphate of Potassa added to the Sulphate of Alumina.

Chem. Relations. Alum, which is a double Sulphate of Alumina and Potassa, is the type of a large class of salts, having the same general formula. Thus we may substitute for the *Potassa*,—Soda, Lithia, Ammonia, Magnesia, the *Protoxides of Iron* and *Manganese*; for the Alumina, the *Sesquioxides* of Iron, Manganese, or Chromium; for the *Sulphuric Acid*, Selenic, Silicic, or Chromic Acid. The minerals *Feldspar*, *Albite*, *Spodumene*, and *Petalite*, are Alums of *Silicic Acid*, SiO_3 , with KO_2NaO , and Lithia respectively. In some of these forms the properties of the Alum do not differ from those of common, or *Potash Alum*.

Prop. Transparent, crystalline, slightly efflorescent salt, of a sweetish, astringent taste, acid reaction. The crystals contain 24 eq. of water, which they lose at a high heat, forming B. *ALUMEN EXSICCATUM. They are

soluble in 14 to 15 times their weight of cold, and three-fourths their weight of boiling water, from which the salt crystallizes on cooling.

Impurities. Generally contains a little IRON.

Med. Effects. Small doses, gr. v to x, astringent and antispasmodic.

In large doses, 3ss, emetic and purgative.

Externally astringent.

Incompat. Those of the soluble Sulphates; the Alkalies, their Carbonates, Lime Water, Magnesia, Tartrate of Potassa.

METALS PROPER, WHOSE HIGHER OXIDES ARE ACIDS.

XXI. MANGANESE. Mn. 27·67.

Prep. By reducing Carbonate of Manganese by *Carbon* at a high heat.

Prop. Grayish-white metal, resembling some varieties of cast iron; hard, brittle, not magnetic; Sp. Gr. 8; readily oxidizes; fuses with difficulty.

Chem. Rel. Forms with O, Protoxide, MnO ; Sesquioxide, Mn_2O_3 ; BINOXIDE, MnO_2 ; Manganic Acid, MnO_3 ; Permanganic Acid, Mn_2O_7 . The first two are basic; the third, neutral; the two last, acid (p. 76). Of these, the Binoxide or Black Oxide is the most abundant and useful, and is used in preparing the salts of the metal;

when added to an acid, one eq. of O is given off, and a salt of the *Protoxide* is formed. If a hydracid, this O combines with the H, liberating the electro-negative constituent. The *Sesquioxide* is a feeble base, and unimportant. The Salts of the *Protoxide* are colourless, or of a pale rose colour.

Med. Effects. As Manganese exists in minute quantity in the blood, it has been given in cases of anaemia, where iron had failed. The *Sulphate* is, in large doses, ʒj to ʒij, a cholagogue cathartic. The *Iodide*, *Carbonate*, *Phosphate*, and *Tartrate* have been employed.

None of the preparations of Manganese are officinal.

XXII. IRON (FERRUM). Fe. 28.

Prep. Obtained from its ORES (Oxides, Carbonates), by reducing with C, at a high heat; also, by passing a current of H over its Oxide, at about a red heat (**FERRI PULVIS*).

Prop. Pure iron is a soft, malleable, ductile metal, of a whitish colour, pure metallic lustre, styptic taste, and sensible odour, when rubbed; Sp. Gr. 7.8; the most tenacious of all metals; possesses magnetic and welding properties; combustible; burns in ordinary air when finely divided, or heated to whiteness, and with vivid scintillations in O; it is unaltered in dry air, and under water, deprived of air; in moist air becomes covered with rust,

which is a HYDRATED SESQUIOXIDE; at a red heat, its surface becomes converted into the BLACK OXIDE (*Magnetic Oxide*, Fe_3O_4 or $\text{FeO},\text{Fe}_2\text{O}_3$). It is the most abundant of all the metals; found in most mineral and many vegetable and animal substances.

Chem. Rel. Unites with most of the metals, and with all the non-metallic elements, except H? and B. It forms with O, 1. PROTOXIDE, FeO , which may be obtained by precipitating a salt of the Protoxide with a Caustic Alkali; it forms a whitish Hydrate, losing its water, and becoming black, when boiled; is attracted by the magnet; exposed to the air, turns green, and ultimately brown, absorbing O and becoming SESQUIOXIDE; it sometimes absorbs O with such avidity as to take fire; is powerfully basic. Its salts are generally of a delicate green colour, and nauseous, metallic taste; they absorb oxygen readily, becoming brown, from the formation of Sesquioxide. 2. SESQUIOXIDE, Fe_2O_3 , prepared by precipitating a salt of the Sesquioxide by Caustic Alkali, and igniting the Hydrate thus formed; is of a red colour; not attracted by the magnet; unaltered by heat; reduced by a current of Hydrogen, at a red heat, or by C, at a higher heat; is feebly basic. Its salts, formed generally by oxidizing those of the Protoxide, have a reddish or brown colour, a styptic, astringent taste, and an acid reaction. 3. BLACK OXIDE—*Magnetic Oxide*, Fe_3O_4 , is most probably a combination of $\text{FeO},\text{Fe}_2\text{O}_3$; does not form salts. Ferric

Acid, FeO_3 , has not been isolated; its Potassa salt forms a deep amethystine-red solution, which soon decomposes; it forms with Baryta, a deep crimson, insoluble, permanent salt. With Sulphur, Iron forms three SULPHIDES : 1. PROTOSULPHIDE, FeS , made by heating together two parts, by weight, of Iron and one of Sulphur; is a blackish, brittle substance; attracted by the magnet; of a decided odour of HS; is used for the preparation of HS, by the addition of a dilute acid. 2. *Bisulphide, Iron Pyrites*, FeS_2 , and the 3. Magnetic Pyrites, Fe_2S_7 , are found native; by exposure to moist air, they absorb O, becoming Sulphate of the Protoxide of Iron. Iron is officinal as metal, as Hydrated Sesquioxide, Nitrate, Sub- and Proto-carbonate, Sulphate, Phosphate, Sesquichloride, Iodide, Tartrate of Iron and Potassa, Citrate, Ferrocyanide, and Ammoniated Iron.

Tests. With Salts of the Sesquioxide of Iron, to which the Protosalts may be converted by boiling with NO_3 . FERROCYANIDE OF POTASSIUM, gives a deep blue precipitate (Prussian Blue). Tincture of Galls, an intense bluish black (Ink). Sulphocyanide of Potassium, a blood-red tinge. Salts of the Protoxide give with FERRICYANIDE of Potassium, a light blue precipitate (Turnbull's Blue).

Incompat. The Alkalies, the Alkaline Carbonates, the Vegetable Astringents.

Gen. Med. Effects. Iron exists in the BLOOD, in which

Liebig supposes it to act as a carrier of Oxygen and Carbonic Acid, becoming Sesquioxide in the lungs, existing as such in the arteries, reduced to Protoxide in the capillaries, and returned as Carbonate of the Protoxide by the veins. It is deficient in anaemia, and like diseases. Is employed as a tonic, and its salts are in addition astringent.

A. AS METAL.

Officinal Forms. *a. *FERRI FILUM—Iron Wire.* Used generally in making preparations from metallic iron.

*b. *FERRI RAMENTA—Iron Filings.* Should be prepared by filing a clean piece of iron, as those obtained at machine-shops are impure. Enter into combination with the acids of the stomach, forming soluble salts, with the evolution of H, which sometimes causes unpleasant eructations.

*c. *FERRI PULVIS—Powder of Iron.* Quevennes Iron. Iron by Hydrogen.

Prep. by passing a current of H over Fe_2O_3 , at a dull red heat; the H unites with the O of the Fe_2O_3 , to form water, leaving the Iron in a state of fine division.

Prop. Tasteless, gray powder, dissolving rapidly, with effervescence of H, in dilute acids. Differs from *FERRI RAMENTA only in being in a state of more minute division. Dose, gr. iii to vi.

B. OXIDE.

d. FERRI OXIDUM HYDRATUM—Hydrated Sesquioxide of Iron, Fe₂O₃,3HO.

Ferri. Sulphat. ʒiv; Acid. Sulphuric. fʒijss; Acid. Nitric. fʒvi or q. s.; Liq. Ammoniae q. s.; Aquæ, Oij.

Prep. Dissolve the Sulphate of Iron in the water, and having added the Sulphuric Acid, boil the solution; then add the Nitric Acid in small portions, boiling the liquid a minute or two after each addition, until the acid ceases to produce a dark colour; filter the liquid, and when cool, add an excess of the Solution of Ammonia, stirring the mixture briskly; wash the precipitate, until the washings cease to afford a precipitate with Chloride of BARIUM, and keep in well-stopped bottles, with sufficient water to cover it.

Rem. The *Protoxide* of Iron in the Sulphate is, by the action of the Nitric Acid, converted into Sesquioxide, NO₂ being given off, which, taking two of O from the air, becomes NO₄, producing the red fumes seen to arise; 6FeO,SO₃ and NO₅ = 3(Fe₂O₃,2 SO₃) and NO₂: this is a BASIC salt; an equivalent of Sulphuric Acid is added, to make it neutral (see p. 76). 3(Fe₂O₃,2SO₃) + SO₃ = 3(Fe₂O₃,3SO₃); this solution of the neutral sulphate of the Sesquioxide of Iron, Fe₂O₃,3SO₃, is a dark, reddish-brown, permanent liquid; by the addition of *Liq. Ammoniae*, soluble Sulphate of Ammonia is formed, and insoluble hydrated Sesquioxide of Iron precipitates, and is separated

by filtration: $\text{Fe}_2\text{O}_3 \cdot 3 \text{SO}_3$, and $3 \text{NH}_4\text{O} \cdot \text{HO} = 3 \text{NH}_4\text{O}$, SO_3 and $\text{Fe}_2\text{O}_3 \cdot 3 \text{HO}$.

Prop. A brownish pulpy mass, freely soluble in acids; when long kept, undergoes a change, becoming crystalline, and losing one-half of its water; its virtues as an ANTIDOTE are then impaired; it also quickly becomes crystalline, when frozen; immediately at 21° (F.) (Limberger); does not, however, then lose its water, as when long kept; although less soluble than the amorphous, is more so than that which has become crystalline, and less hydrated by long keeping (Wittstein); the best plan is to keep the solution of $\text{Fe}_2\text{O}_3 \cdot 3\text{SO}_3$, and precipitate it as wanted; if this be not at hand, the *TINCTURA FERRI CHLORIDI may be treated in a similar manner by *Liq. Ammoniae*, the hydrated sesquioxide will precipitate, Fe_2Cl_3 , and $3 \text{NH}_4\text{O} \cdot \text{HO} = 3 \text{NH}_4\text{Cl}$ and $\text{Fe}_2\text{O}_3 \cdot 3 \text{HO}$.

Med. Uses. Used sometimes as a tonic; most valued as an antidote to *ARSENIOUS ACID. (See ARSENIC.)

C. NITRATE.

c. LIQUOR FERRI NITRATIS—Solution of Nitrate of Iron.

Prep. Is made by dissolving metallic Iron in Nitric Acid.

R. *Ferri fil.* ȝj; *Acid. Nitric fȝijj;* *Aq. q. s.* ȣā
fȝxxx.

4NO_5 and $2\text{Fe} = \text{Fe}_2\text{O}_3, 3 \text{NO}_5$ and NO_2 ; the solution is therefore a neutral *Nitrate of the Sesquioxide*.

Rem. As this solution is liable to change, depositing a Subnitrate of the Sesquioxide, it had better be prepared according to Procter's formula, which is, to add the Iron gradually to dilute NO_5 , filtering immediately after all the Iron has been thrown in and dissolved, heating the filtrate gently, carefully dropping in NO_5 , avoiding an excess, until a drop of the solution yields a red tinge, without a trace of black, with NH_4O : the object of this process is to avoid the formation of Protoxide.

Prop. A transparent, wine-coloured liquid, with a very astringent, not caustic taste.

Med. Effects. In addition to those of Iron generally, has been strongly recommended in Chronic Diarrhoea, unattended with ulceration of the mucous membrane of the intestines; is decomposed by most medicinal agents, and should not therefore be given in combination.

D. CARBONATES.

*f. *FERRI SUBCARBONAS—Subcarbonate of Iron—Precipitated Carbonate of Iron.*

Prep. Is made by the double decomposition of Sulphate of Iron and Carbonate of Soda.

R. Ferri. Sulphat. ʒ viii; Sodæ Carb. ʒ ix; Aq. Bull. Cong. j; dissolve the Sulphate of Iron and Carbonate of Soda, each in Oiv of the water, and mix the solu-

tions, stir them, allow the precipitate to subside, pour off the supernatant liquid, and wash the precipitate, wrap it in bibulous paper, and dry at a *gentle* heat. FeO_2SO_3 and $\text{NaO}_2\text{CO}_2 = \text{NaO}_2\text{SO}_3$ and FeO_2CO_2 .

Prop. When first thrown down, is a pale, bluish precipitate, of Hydrate of Protocarbonate of Iron, $\text{FeO}_2\text{CO}_2\text{HO}$; on exposure to the air, it rapidly absorbs O and loses CO_2 , becoming Sesquioxide, and retaining but a trace of CO_2 ; it is then a reddish-brown powder, insoluble in water, and soluble with difficulty in acids, except HCl; when it has been strongly heated, it is anhydrous, and is injured; the ordinary (hydrated) Subcarbonate may be used as an antidote to ARSENIOUS ACID, in the absence of the hydrated Sesquioxide, but if it has been thoroughly heated, is useless.

Med. Uses. Besides its tonic effects, is used in large doses as an antispasmodic.

Dose, gr. v to $\frac{3}{ss}$.

*g. *PILULÆ FERRI CARBONATIS—Pills of the Carbonate of Iron. Valley's Mass.*

R. Ferri Sulph. $\frac{3}{viii}$; Soda Carb. $\frac{3}{x}$; Mel. Despum. $\frac{3}{iij}$; Sacch. pulv. $\frac{3}{ii}$; Aq. Bull. Oij; Syrup. q. s. Dissolve the Sulphate of Iron and Carbonate of Soda, each in Oj of water, to which has been previously added f $\frac{3}{3}$ Syrup; mix the two solutions, pour into a bottle, closely stopped, just large enough to hold them, and allow the precipitate to subside: pour off the supernatant liquor,

wash the precipitate with water sweetened with Syrup (fʒj to Oj), until the washings have no longer a saline taste; place it upon a flannel cloth to drain, and afterwards express as much water as possible; then immediately mix with the honey and sugar, by means of a water-bath; evaporate with constant stirring to a pilular consistence.

Rem. The decomposition is the same in this process as the last, the hydrated Protocarbonate is, however, protected from further change, by the use of sugar and honey.

Prop. A soft, pilular mass, black on the surface, when kept, but whitish within; when well made, is wholly and freely soluble in acids: it keeps well.

Med. Uses. One of the least offensive and most efficient of the ferruginous preparations.

Dose, gr. iii to vi.

*h. *MISTURA FERRI COMPOSITA—Compound Mixture of Iron—Griffith's Antihectic Mixture.*

R. 1. *Myrrh.* ʒj; 2. *Potass. Carb.* gr. xxv; 3. *Ferri Sulph. Pulv.* ʒj; 4. *Spt. Lavand.* fʒss; 5. *Sacch.* ʒj; 6. *Aq. Rosar.* fʒviiss.

Prep. Rub 1 with 6 gradually added; add, then, 4, 5, 2, and lastly 3; pour the mixture immediately into a glass bottle, to be kept well stopped.

Rem. The KO₂CO₂ and FeO,SO₃ react, to form FeO, CO₂ and KO₂SO₃; the excess of KO₂CO₂ forms a soapy compound with the Myrrh; the mixture is therefore an emulsion, containing besides the vehicles, Protocarbonate

(gradually becoming Subcarbonate) of Iron, Sulphate of Potassa, Carbonate of Potassa, Myrrh, and Spts. of Lavender. It should be prepared when wanted.

Med. Effects. Those of Iron and Myrrh. *Dose*, fzj to fzij.

i. ***PILULÆ FERRI COMPOSITA**—*Compound Iron Pill.*

R. 1. *Myrrhæ Pulv.* 3ii; 2. *Sodæ Carb.*; 3. *Ferri Sulphat.* aa 3j; *Syrup.* q. s.

Prep. Rub 1 with 2, add 3, and again rub; lastly, beat with 4, and form a mass, to be divided into eighty pills.

Rem. Those on the last preparation will apply to this. The pills change rapidly, and should be prepared when wanted. *Dose*, ii to vi.

E. **SULPHATE.** FeO_2SO_3 .

k. ***FERRI SULPHAS**—*Sulphate of (the Protoxide of) Iron*—Green Vitriol.

Prep. Is obtained on the large scale by the spontaneous oxidation of Iron Pyrites, FeS_2 : this is impure; for medicinal use, it is prepared by dissolving pure iron wire in dilute Sulphuric Acid, adding a slight excess of acid, filtering with as little contact of air as possible, and crystallizing.

Prop. When pure, is in bluish-green, transparent crystals; styptic taste; acid reaction; soluble in 2 parts cold, and $\frac{1}{2}$ boiling water; the crystals contain 7 eq. water of .

crystallization, 6 of which they lose by heat (Ferri Sulphas Exsiccatum of the Ed. Ph.); exposed to the air, becomes green, and finally covered with a brownish efflorescence of Subsulphate of the Sesquioxide; its solution is a pale green, becoming dark from absorption of O.

Med. Effects. Tonic and astringent; should be dried before making into pills. *Dose*, gr. i to v.

Incompat. Those of Sulphuric Acid, and the salts of Iron generally.

F. PHOSPHATE.

l. *FERRI PHOSPHAS—*Phosphate of Iron.* $2\text{FeO}, \text{HO}, \text{PO}_5$,

Prep. Is made by double decomposition of *PHOSPHATE OF SODA (6 parts by weight), and SULPHATE OF IRON (5 parts by weight); Sulphate of Soda and Phosphate of Iron result, $2\text{NaO}, \text{HO}, \text{PO}_5$, and $2(\text{FeO}, \text{SO}_4) = 2\text{FeO}, \text{HO}, \text{PO}_5$ and $2(\text{NaO}, \text{SO}_4)$; the insoluble Phosphate is filtered from the solution of the Sulphate, washed and dried; it is a tribasic Phosphate of the Protoxide of Iron.

Prop. Bright, slate-coloured powder, insoluble in water, but soluble in acids, which decompose it; it may be dissolved unchanged in *Metaphosphoric* (Monohydrated Phosphoric) Acid, HO, PO_5 .

Med. Effects. Those of its constituents. *Dose*, gr. v to x.

G. CHLORIDE.

*m. *TINCTURA FERRI CHLORIDI—Tincture of the Chloride of Iron—Muriated Tincture of Iron.*

Prep. Is made by dissolving *Ferri Subcarb.* (lbss) in *Acid. Muriatic.* (Oj), and adding *Alcohol* (Oii).

Rem. As the **FERRI SUBCARB.* is in the main a sesquioxide, with but little CO₂, the reaction may be given thus : Fe₂O₃ and 3 HCl = Fe₂Cl₃ and 3 HO ; the SESQUI-CHLORIDE thus formed is dissolved in the Alcohol ; the preparation is therefore an alcoholic solution of the Sesqui-chloride of Iron.

Prop. A clear, reddish liquid, with a pleasant æthereal odour, and an agreeably acid astringent taste ; it is not prone to spontaneous decomposition.

Med. Effects. Externally, styptic and astringent ; internally, tonic and astringent ; used internally in vesical affections, gleet, spasmodic stricture, hemorrhages, leucorrhœa, anaemia, &c. ; has been used as a remedy in erysipelas and yellow fever ; the aqueous solution has been used as an injection in aneurism ; is one of the most eligible and efficient of the preparations of Iron.

Incompatibles. The stronger Acids, Alkalies, Alkaline Carbonates, Nitrate of Silver, Vegetable Astringents, and Mucilage of Gum Arabic ; Albumen is instantly coagulated by it.

*n. *FERRUM AMMONIATUM—Ammoniated Iron—Ammonio-chloride of Iron.*

Prep. R. *Ferri Subcarb.* ʒiii; *Acid Muriatic fʒx*; mix, digest for two hours, and add *Ammon. Muriat.* Ibiiss, dissolved in *Aq. Destill.* Oiv; filter, and evaporate to dryness: is a mixture of Sesquichloride of Iron and Chloride of Ammonium.

Prop. Crystalline grains, of a fine orange-reddish colour, and styptic taste; is deliquescent; freely soluble in water and alcohol.

Med. Effects. Those of its constituents. Dose, gr. iv to xii.

H. IODIDES.

o. *FERRI IODIDUM—Iodide of Iron.

Prep. Is made by direct union of the elements.

Iron Wire (ʒj) is added gradually to *Iodine* (ʒij), mixed in Distilled Water (Oj), with the application of a gentle heat, until the liquid acquires a greenish colour. It is then filtered, the filter washed with boiling, distilled water (Oss), and the solution carefully evaporated, in an iron vessel, over a water-bath, to dryness. It must be kept in a well-stopped bottle.

Prop. A greenish-black, crystalline solid; very deliquescent; styptic, chalybeate taste; is soluble in water and alcohol; decomposes spontaneously, when exposed to the air, Sesquioxide of Iron being formed, and Iodine liberated.

Med. Effects. Possesses the therapeutic properties of

Iodine and Iron, and is hence largely used where these agents are indicated. Also employed as an astringent externally. Dose, gr. j to viii. Being prone to decompose and inconvenient to dispense, it is used generally in the form of the

*p. *LIQ. FERRI IODIDI — Solution of the Iodide of Iron.* Is made by a process essentially the same as the last, save that the solution is not evaporated to dryness, and sugar is added to protect the salt from decomposition.

($\frac{3}{2}$ j) *Iron Wire* is gradually added to ($\frac{3}{2}$ ij) *Iodine*, diffused in ($\frac{1}{2}$ ʒv) *Distilled Water*, gently heated, until combination takes place. The solution is filtered into a bottle containing ($\frac{3}{2}$ xii) *Sugar*, and *Distilled Water* poured on to the filter, until the contents of the bottle measure f $\frac{3}{2}$ xx. The bottle is shaken until the sugar is dissolved. A little iron wire placed in the bottle assists the sugar in preventing change. The solution contains $7\frac{1}{2}$ gr. of solid *Iodide* to f $\frac{3}{2}$ j.

Prop. Transparent liquid; pale greenish colour; sweetish, styptic, astringent taste.

Med. Effects. Those of the *Iodide*; should be given alone and largely diluted; it should be dropped into a glass vessel, as it is decomposed by the metals.

Dose, gtt. x to xxx.

*q. *PILULÆ FERRI IODIDI — Pills of the Iodide of Iron.*

R. Ferri Sulphat. 3j; *Potass. Iodid.* 3iv; *Traga-*

canth. *Pulv.* gr. x; *Sacch.* *Pulv.* ʒss, with syrup, to form a mass to be divided into forty pills.

Rem. The FeO_3SO_3 and KI, react to form KO_3SO_3 and FeI. The pills contain, therefore, besides the excipients, Sulphate of Potassa and Iodide of Iron; rapidly decompose. Each pill contains about gr. iss of the Iodide of Iron.

I. ORGANIC COMPOUNDS.

*r. *FERRI ET POTASSÆ TARTRAS—Tartrate of Iron and Potassa.* Is made by saturating the *BITARTRATE OF POTASSA with Sesquioxide of Iron. The Bitartrate is mixed with water and heated to 140° and kept at that temperature, *HYDRATED SESQUIOXIDE OF IRON is then added as long as it dissolves; the solution filtered, evaporated, and spread upon plates of glass or porcelain to dry.
 $\text{KO}_3\text{HO}_3\bar{T}$ and $\text{Fe}_2\text{O}_3 = \text{KO}_3\text{Fe}_2\text{O}_3\bar{T}$ and HO_3 .

Prop. Transparent, ruby-red scales; slightly chalybeate taste; soluble in about 4 parts water.

Med. Effects. Those of Iron generally. Is sometimes preferred, from its slight taste. Dose gr. x to ʒss.

s. FERRI CITRAS—Citrate of Iron.

Is made by dissolving *HYDRATED SESQUIOXIDE OF IRON in a solution of *CITRIC ACID, kept at 150° , to saturation; the solution is then treated as in the last preparation.

Prop. Resembles the last preparation; the scales are

of a lighter colour, and less soluble, and sapid; contains about 34 per cent. of Fe_2O_3 .

Med. Effects. Those of Iron generally; is an agreeable preparation. Dose gr. v to 3j.

A *Citrate of Iron and Quinia*, not officinal, is much used. It is prepared by dissolving 3j Quinia (recently precipitated), 3ij Citric Acid, 3v Citrate of Iron, in f 3xii Distilled Water, constantly stirring and keeping below the boiling-point. The solution is filtered and treated as above.

t. *FERRI FERROCYANURETUM—*Ferrocyanuret* (ferrocyanide) of Iron—Prussian Blue. Fe_4Cf_y_3 ?

Prep. Is generally prepared on the large scale; is formed when FERROCYANIDE OF POTASSIUM is added to a salt of the Sesquioxide of Iron.

Prop. Deep blue, tasteless, inodorous, insoluble powder.

Med. Effects. Tonic, antiperiodic, antispasmodic.

Dose gr. iii to 3j.

XXIII. CHROMIUM. Cr. 28·15.

Nat. Sources. Exists native as Oxide, and as native Chromate of Lead. Is obtained by reducing the Oxide by C.

Prop. Hard, grayish-white, brittle metal; Sp. Gr. 5·9; very difficult of fusion, and does not oxidize readily.

Gen. Chem. Rel. Resembles closely Manganese and Iron; with O, forms *Protoxide*, Cr_2O ; *Sesquioxide*, Cr_2O_3 .

a. *Chromic Acid*, CrO_3 —*Perchromic Acid*, Cr_2O_7 . *Chromic Acid* is prepared by the action of strong HO_2SO_3 upon *Bichromate of Potassa*. It crystallizes in brilliant red prisms; very deliquescent, and soluble in water. It has been used in medicine as an escharotic. It rapidly dissolves organic matter, and is a powerful oxidizing agent. Chromate of Lead is used in the arts as a paint, known as Chrome Yellow. It is poisonous, but no case has been recorded of its effects on the human subject.
Antidotes, albumen, flour.

b. *Bichromate of Potassa*, KO_2CrO_3 , possesses the properties of CrO_3 , but in a milder degree. It is used as an escharotic, and as an oxidizing agent. It is officinal in the Dublin Pharmacopœia. Internally, in large doses, is an irritant poison. *Antidotes*: mild alkalies, demulcents. Has been used in small doses (gr. $\frac{1}{5}$, gradually increased) in secondary syphilis. None of the other preparations of Chromium are used in medicine. Workmen engaged in manufactures, where it is used, are liable to painful ulcerations.

XXIV. TIN (STANNUM). Sn. 58.82.

Nat. Sources. Native oxide, is obtained by reduction with C.

Prop. Brilliant, silver-white, soft, malleable metal.. Sp. Gr. 7.3. When bent, or twisted, emits a peculiar sound—the *cry* of tin. Fuses at 442°; oxidizes with difficulty below its melting-point, hence largely used to protect iron surfaces; dissolves in HCl, and is oxidized by NO₅.

Gen. Chem. Rel. Forms three oxides: two of which *protoxide*, SnO, and *Binoxide*, SnO₂, act either as acids, or bases, and a *sesquioxide*, Sn₂O₃. The *protochloride*, made by dissolving the metal in hot HCl, is used as a reducing agent; and as such, as a test for *BICHLORIDE OF MERCURY.

Offi. Prep. But one preparation of tin is officinal: its powder.

a. *PULVIS STANNI—*Powder of Tin.* Is made by stirring melted tin, while cooling, until it is reduced to powder, which is passed through a sieve.

Med. Effects. Anthelmintic. Dose, ʒss, in syrup, or molasses.

XXV. BISMUTH. Bi. 70.95.

Nat. Sources. Found native, and as oxide.

Prop. Brittle, highly crystalline, reddish-white metal. Sp. Gr. 9.9; melts at 500°; burns, or volatilizes in strong heat.

Chem. Rel. Forms three oxides: *Teroxide* (basic),

BiO_3 ; *Peroxide*, BiO_4 ; and *Bismuthic Acid*, BiO_5 . The second of these may be regarded as a union of the first and last ($\text{BiO}_3\text{BiO}_5 = 2\text{BiO}_4$). The metal dissolves in nitric acid; 8 parts, with 5 lead, and 3 tin, forms *fusible alloy*, which melts below 212° . The *nitrate*, thrown into water, is decomposed, a white precipitate resulting—the *subnitrate*, which is officinal. Its salts are easily distinguished by their decomposition, when added to water, and by the blackening effects of HS.

*Offi. Prep. a. *BISMUTHI SUBNITRAS*—Subnitrate of Bismuth. R. *Bismuth* 3j; *Acid. Nitric.* f 3ij; *Aq. Destill.* q. s. The bismuth, in fragments, is dissolved in the nitric acid, with the evolution of red fumes (Bi and $4\text{NO}_3 = \text{BiO}_3\text{, }3\text{NO}_5$, and NO_2). The nitrate, added to water, throws down the *SUBNITRATE*. The water acts as a base to part of the NO_3 , which leaves the oxide; the nitrate thus becomes basic, and insoluble. The composition of the precipitate is not constant, but is generally $\text{BiO}_3\text{NO}_5 + 2\text{HO}$.

Prop. Tasteless, inodorous, white, slightly soluble, heavy powder; dissolves freely in strong acids; alkalies dissolve it sparingly. It sometimes contains Arsenic. Is much used as a cosmetic; but blackens upon exposure to *Hydrosulphuric Acid*.

Med. Effects. Tonic, antispasmodic. Dose, gr. v to 3j. Externally, sedative, astringent. Used, suspended in water, as an injection in gonorrhœa, or leucorrhœa.

XXVI. ARSENIC. As. 75.

Nat. Sources. Found native—as sulphides (orpiment, realgar), and in combination with iron, nickel, and cobalt. Is obtained from ARSENIOUS ACID, by reduction with C.

Prop. Steel-gray, brittle, crystalline metal; very brilliant, when recently broken, but rapidly tarnishing; when rubbed, or heated, exhales a peculiar odour; Sp. Gr. 5·8. Heated to 357°, volatilizes without fusion; and if air be present, oxidizes to ARSENIOUS ACID.

Chem. Rel. Forms three oxides, two of which are acids—Suboxide, AsO (?) ; *ARSENIOUS ACID, AsO_3 , and Arsenic Acid, AsO_5 . The latter is obtained from the former, by boiling to dryness with nitromuriatic acid; is a white substance, having powerfully acid properties. It is soluble in water, and gives a brick-red precipitate with Nitrate of Silver; with Hydrogen, Arsenic forms AsH_2 , solid Arsenide of H; and AsH_3 , Arsenetted Hydrogen, a gas. Three Sulphides, Realgar, AsS_2 ; Orpiment, AsS_3 , and Pentasulphide, AsS_5 . It combines also with the other non-metallic elements. The Metal, Arsenious Acid, the Iodide of Arsenic, and the Arsenite of Potassa, are officinal.

Tests. See ARSENIOUS ACID.

Gen. Med. Effects. The preparations of Arsenic are tonic, alterative, antispasmodic, and antiperiodic.

Officinal Forms. a. *ARSENICUM—Arsenic. Is only

used for making the *IODIDE, and the *IODIDE OF ARSENIC and MERCURY (*Donovan's Solution*).

A. OXIDE.

b. *ACIDUM ARSENIOSUM—*Arsenious Acid*. White Arsenic, Arsenic, Rats-bane. Sublimed Arsenious Acid, in masses, U. S. P. It is obtained, on the large scale, by roasting the ores which contain the metal; after which it is purified by sublimation.

Prop. Is found in two distinct varieties : 1. Transparent, or Vitreous variety, is a transparent, colourless glass. Sp. Gr. 3·2 to 3·8. Is more soluble than the opaque variety, into which it gradually passes, upon exposure to the air. 2. The opaque variety is of a milk-white colour, slightly heavier than the transparent, into which it passes by long boiling. Arsenious Acid dissolves sparingly in cold water; 1 part dissolving in from 50 to 480 parts of water. In boiling water, both varieties are equally soluble; 1 part dissolving in from 7·72 to 24 parts. The boiling solution deposits the greater part upon cooling; but retains more than if the acid were simply added to cold water—about 1 in 30. The solution has an austere, sweetish taste. The solid acid sublimes at 425°, giving no garlicky odour, unless in the presence of reducing agents; it condenses on a cold surface, in *octohedral* crystals (very rarely in *right rhombic* crystals).

Adulterations. When in powder, may be adulterated

with chalk, or flour. Should be entirely sublimed by heat.

Med. Effects. Those of the preparations of Arsenic generally. Dose, gr. $\frac{1}{6}$ to $\frac{1}{6}$, in pill or solution.

Externally, a powerful escharotic; there is danger of its absorption when thus used.

Toxicological Effects. Depend upon the quantity; in large doses, the symptoms are those due to a violent irritant, and vary in different cases, the nervous system being often affected; they appear in from one minute to ten hours; death ensues, in fatal cases, in from $2\frac{1}{2}$ hours to 3 days; the minimum quantity necessary to destroy life at a single dose, is four grains; cases have recovered, after taking an ounce. Post-mortem examination reveals inflammation, ulceration, and gangrene of the stomach and intestines; in small doses long continued, or after large doses from which death has not resulted, there is irritation and itching of the eyes, eyelids, conjunctivitis, oedema, irritability of the stomach, eczematous eruption, desquamation of the cuticle, loss of the hair, emaciation, salivation, and paralysis; the symptoms have been mistaken for those of cholera, perforation of the intestine, gastritis, &c.

Antidotes. 1. Hydrated Sesquioxide of Iron, it should be freshly precipitated and freely given, a tablespoonful of the magma every 5 or 10 minutes, until the urgent symptoms are relieved; it acts, by giving a portion of O to the Arsenious Acid, converting it into Arsenic A., which

forms an insoluble basic compound with the Protoxide of Iron, $2 \text{Fe}_2\text{O}_3$ and $\text{AsO}_3 = 4 \text{FeO}, \text{AsO}_5$.

2. In the absence of this, the **Ferri Subcarb.* may be given, but is often inert, from having been overheated.

3. Magnesia, recently and not too highly calcined, or recently precipitated, has been found efficient.

Tests. A. When solid. 1. Heat to redness in a glass tube, closed at one end with fragments of charcoal; the AsO_3 is reduced, the metallic arsenic sublimed, and forms the arsenical mirror or ring in the tube. By breaking the tube, and allowing free access of air, the metal is oxidized again into AsO_3 , and may be submitted to other tests; the octohedral crystals of AsO_3 may be seen in the second sublimate; the mirror must be distinguished from that produced by Antimony (see Test 6).

2. Arsenious Acid thrown upon coals, or other reducing agents, exhales a peculiar garlicky odour, which is not perceived when it is sublimed from a clean surface; it is probably due to the formation of suboxide AsO .

B. In solution. 3. Ammonio-Nitrate of Silver gives a rich yellow precipitate of Arsenite of Silver, soluble in excess of Ammonia, and in Nitric, Tartaric, Acetic, and Citric Acid, but not in Caustic Potash or Soda; a solution of an alkaline phosphate precipitates yellow, with Nitrate of Silver, and a dilute solution of Phosphoric Acid with the Ammonio-Nitrate. It is discriminated by the application of the other tests.

4. Ammonio-Sulphate of Copper, a brilliant yellowish-green precipitate of Arsenite of Copper (Scheele's Green), soluble in acids, and in excess of Ammonia, but not in Potash or Soda; Acetic and Malic Acids give also green precipitates with the Ammonio-Sulphate of Copper, as do certain complex organic mixtures (Taylor).

5. Hydrosulphuric Acid gives a golden yellow precipitate (Orpiment, AsS_3), soluble in alkalies; the solution should be, therefore, slightly acidulated before trial; other metals (Antimony, Tin, Uranium), give somewhat similar precipitates; they are distinguished by their behaviour with the other tests.

6. Marsh's Test. Add the suspected liquid to *pure Zinc*, and dilute SO_3 ; Arsenetted Hydrogen (AsH_3) is generated; may be known by its odour, its violet-coloured flame, and by the metallic stain deposited upon a cold, white surface; or the gas may be passed through a long tube drawn out, heated at its centre; the metal deposits as in Test 1, and may be further examined.

Antimonetted Hydrogen, SbH_3 ?, gives similar spots from the reduction of the metal; they may be distinguished, 1. By Nitric Acid, which converts the metallic Arsenic into AsO_5 , which is *soluble*, and gives a brick-red precipitate with Nitrate of Silver, while Antimony is converted into *insoluble* Antimonic Acid. 2. The spot is heated to 500° by an oil-bath; if Arsenic, it disappears; if Antimony, remains. 3. Hypochlorite of Soda dissolves Arsenical

spots, but does not affect those of Antimony. 4. Tincture of Iodine instantly dissolves Arsenic spots, leaving, on spontaneous evaporation, a lemon-yellow spot. Antimony is not immediately altered on evaporation; is converted after a time into orange-coloured Iodide. 5. Vapour of Phosphorous Acid (PO_3) causes the disappearance of As spots in 4 or 5 hours; Sb spots remain a fortnight, but finally disappear.

7. Reinsch's Test. A bright slip of copper, or fine copper gauze, is boiled in the suspected solution, previously acidulated with HCl; the metal precipitates upon the copper, from which it may be scraped, or volatilized and submitted to other tests; this process has these advantages: 1. Will act in the presence of organic matter; 2. Gives the metal in condition to be submitted to all the other tests.

Appreciation of these Tests. No single test is to be relied upon; and wherever practicable, all should be applied. The relative delicacy of the tests is given by Devergie, as follows: Ammonio Sulphate of Copper, 5,200; Sulphuretted Hydrogen, 200,000; Ammonio-Nitrate of Silver, 400,000. By the latter, the $\frac{1}{8000}$ to the $\frac{1}{10000}$ of a grain may be rendered evident, if dissolved in but a drop or two of water; in one fluid-drachm of water, it detected the $\frac{1}{173}$ of a grain. Marsh's Test will detect, according to Danger and Flandin, the $\frac{1}{2000660}$ part of the liquid examined; according to Signoret, the $\frac{1}{200000000}$. Vil-

lain states that one grain will give, on an average, 226 metallic deposits, of an average diameter of $\frac{1}{12}$ of an inch, or will detect about the $\frac{1}{75000}$ of a grain. Reinsch's Test will detect, when the Arsenic forms the $\frac{1}{90000}$ of the liquid, or the $\frac{1}{4000}$ of a grain (Taylor).

Organic matter interferes with all these tests, but least so with Reinsch's ; it renders the liquid tests useless, and causes much frothing with Marsh's Test ; it may be removed by straining, filtration, and the use of oxidizing agents, as strong sulphuric or chromic acids, incineration, &c. For the details of the manipulations, the student is referred to the works on General Chemistry and Toxicology.

Medico-legal Points. It is important to estimate the quantity taken ; to test all reagents carefully before using ; to take every precaution against the sources of fallacy indicated. Arsenic sometimes exists in candles, paper, vinegar ; in the soil of cemeteries ; may be detected in the tissues, after many years ; does *not* exist normally in the body, as has been supposed ; its use in medicine, in painting (Orpiment Realgar, Scheele's Green), must be borne in mind. Poisoning may happen from its long-continued use in minute quantities ; by absorption from its external application ; by Arsenetted Hydrogen ; or by the KAKODYL compounds.

E. IODIDE.

c. *ARSENICI IODIDUM—*Iodide of Arsenic* (AsI_3). Is

made by intimately mixing (3j) Metallic Arsenic, (3v) Iodine, introducing the mixture into a flask or tube, and applying gentle heat, until combination takes place.

Prop. An orange-red crystalline solid, entirely soluble in water, and volatilized by heat.

Med. Effects. Alterative; dose, gr. $\frac{1}{2}$. Externally, in ointment, gr. iij to 3j *Adipis*. Principally used in preparing the *LIQ. ARSENICI ET HYDRARG. IODID., or *Donovan's Solution*. See MERCURY.

c. With POTASSA.

d. *LIQUOR POTASSÆ ARSENITIS—*Solution of the Arsenite of Potassa—Fowler's Solution.*

Is made by boiling equal parts of Arsenious Acid and Carbonate of Potassa (aa gr. lxiv) in Distilled Water (f 3xii), until dissolved, adding Spirit of Lavender (f 3ss) and Distilled Water (q. s. ad. Oj). KO_2CO_2 and $AsO_3 = KO_2AsO_3$ and CO_2 . It contains gr. ss to f 3j. The *Spt. Lavand.* is added to give taste and colour, so as to avoid mistakes.

Med. Effects. Those of Arsenious Acid generally. It is the preparation of Arsenic most employed.

Dose gtt. v to xv.

Tox. Effects. Those of Arsenious Acid. The usual antidotes are not active, unless combined with an acid, so as to liberate the AsO_3 . The antidote employed is the

Acetate of the Sesquioxide of Iron. Cases of poisoning by it are rare.

XXVII. ANTIMONY. Sb. 129·03.

Nat. Sources. Found principally as Sulphide, from which the metal (*Regulus of Antimony*) is obtained by roasting.

Prop. A brittle, brilliant, bluish-white metal; lamellated texture; Sp. Gr. 6·7; melts just below a red heat; boils and volatilizes at a little above; strongly heated burns with a white flame, giving off white fumes of Ter-oxide (Sb_2O_3).

Chem. Rel. Forms four Oxides, one Suboxide, Sb_2O_4 ; TEROXIDE, SbO_3 ; Antimonous Acid, SbO_4 ; Antimonic Acid, SbO_5 ; with H, solid Antimonide of H? and Antimonetted Hydrogen ($SbH_3?$); with S, TERSULPHIDE, SbS_3 , Pentasulphide, Sb_2S_5 , a Sulphur Acid (*Golden Sulphur*); with Cl, TERCHLORIDE, $SbCl_3$, and Pentachloride, $SbCl_5$. The Terchloride (*Butter of Antimony*) is made by dissolving the metal or Tersulphide in HCl; is decomposed on the addition of water, throwing down a white precipitate, the Oxychloride, $SbClO_3?$, or $SbCl_3SbO_3$ (*Powder of Algaroth*). Nitric Acid oxidizes the metal to insoluble Antimonic Acid.

Tests. Hydrosulphate of Ammonia gives, with a soluble salt of Sb, an orange-red precipitate, soluble in excess,

and again precipitated by an acid, also in HCl, which solution precipitates on the addition of water.

A. SULPHIDES.

Officinal Forms. a. *ANTIMONII SULPHURETUM—*Sulphuret (Sulphide) of Antimony*—Native Sulphuret of Antimony, purified by fusion.

Prop. Is a Tersulphide of Antimony, SbS_3 . Brilliant steel gray, striated, brittle masses, soluble in HCl by the aid of heat, with the evolution of HS, forming the *Ter-chloride*. $\text{SbS}_3 + 3\text{HCl} = \text{HCl}_3 + \text{HS}$. Is rarely used in medicine.

b. *ANTIMONII SULPHURETUM PRÆCIPITATUM—*Precipitated Sulphuret (Sulphide) of Antimony*.

Is made by boiling SbS_3 with KO, which throws down *Kermes' Mineral*, a variable mixture of Hydrated Tersulphide with Oxysulphide of Sb, and a little Sulphide of Potassium; dilute SO_3 is added to the mother liquor, which throws down *Golden Sulphur* SbO_3 and SbS_3 ? or SbS_5 . The preparation is a variable compound, SbS_3 , SbO_3 , or $\text{SbS}_3, \text{SbS}_5$, a union of a Sulphur acid with a Sulphur base.

Prop. Reddish-brown, insoluble powder; tasteless when pure; soluble in HCl, with evolution of HS.

Med. Effects. Alterative, diaphoretic, and emetic.

B. TARTRATE.

c. *ANTIMONII ET POTASSÆ TARTRAS—*Tartrate of Antimony and Potassa—Tartar Emetic.*

Prep. Is generally prepared on the large scale. Is made by boiling the Oxychloride (Powder of Algaroth, $SbO_3, SbCl_3$) with Bitartrate of Potassa. The Oxychloride (obtained by the addition of $SbCl_3$ to water) is decomposed during the boiling into SbO_3 and HCl. The latter combines with Iron and other impurities in the KO, HOT , while the former neutralizes the excess of \bar{T} , giving a double salt. SbO_3 and $KO, HOT = KO, SbO_3\bar{T} + HO$, which crystallizes out.

Prop. Transparent, colourless, slightly efflorescent crystals; of a nauseous, metallic, styptic taste; soluble in 12 to 15 parts cold, and 2 or 3 parts boiling water, and in dilute Alcohol, but not in absolute Alcohol. The aqueous solution has an acid reaction, and decomposes by keeping. Is generally sufficiently pure when crystallized; the crystals contain two (one?) equiv. of water of crystallization.

Med. Effects. Nauseant, emetic, purgative, diaphoretic, diuretic, expectorant.

Dose, as nauseant, &c., gr. $\frac{1}{60}$ to $\frac{1}{4}$; as emetic, gr. j to ij.

Externally applied, produces pustulation.

Incompat. Acids, Alkalies, and their Carbonates, some of the earths and metals, Chloride of Calcium,

Acetate and Subacetate of Lead, and Vegetable Astringents.

Toxicol. Effects. In large doses, excessive vomiting, purging, and other effects of irritant poisons. The least quantity required to produce death is not known; recovery has taken place after swallowing two drachms. *Post-mortem* examination reveals gastritis and gastro-enteritis.

Antidotes. Tannic Acid, in any form; Green Tea.

Tests. See ANTIMONY. The preparations of Antimony are very apt to contain ARSENIC. When the poison cannot be detected in the stomach, it should be searched for in the urine or tissues.

*d. *VINUM ANTIMONII—Wine of Antimony—Antimonial Wine.*

Prep. Is made by dissolving 3j *Ant. et Potass. Tart.* in f 3x *Vini* (Sherry).

Rem. It is apt to decompose; contains gr. ij to f 3j.

Dose, varies from gtt. x to 3ss, according to the indication.

*e. *UNGUENTUM ANTIMONII—Ointment of Antimony.*

Prep. 1. *Ant. et Potass. Tart.* (Pulv. Subtil.) 3ij,
2. *Adipis* 3j, rub 1 with a little of 2, add the remainder and mix.

Used externally to produce pustulation.

Besides the above, the Terchloride ($SbCl_3$) is used as an escharotic (*Butter of Antimony*), the *Pulvis Antimo-*

nialis or *James' Powder*, officinal in the Edin. and Dub. Ph's; is made by heating together SbO_3 and horn shavings. It contains SbO_3 ; CaO, PO_5 ; SbO_4 and CaO, SbO_4 . It is irregular in composition and effect, and is not now much used.

XXVIII. LEAD. Pb. 103.56.

Nat. Sources. The native Sulphide, and Phosphate; prepared by roasting.

Prop. Soft, very malleable, bluish metal; Sp. Gr. 11.45; bright, when first cut, but soon tarnishes; melts at 600° , and may be volatilized. Easily oxidizes, at a high heat, into *protoxide*, PbO (Litharge). In moist air, becomes covered with a gray coating of suboxide, Pb_2O .

Chem. Rel. Forms with O Suboxide, $\text{Pb}_2\text{O}(?)$; *PROTOXIDE, PbO (Litharge); *Minium*, or red lead, Pb_3O_4 ; or $2\text{PbO} + \text{PbO}_2$, made by oxidizing, PbO , by exposure to air, at a high heat; Sesquioxide, $\text{Pb}_2\text{O}_3(?)$, and PbO_2 , Plumbic Acid (puce or brown oxide), obtained by digesting *minium* in dilute NO_5 . With NO_5 , soluble *NITRATE, PbO, NO_5 ; with CO_2 insoluble *CARBONATE (White Lead); with S, Sulphide, PbS , Subsulphide, Pb_2S ; with SO_3 , insoluble sulphate; with Cl, sparingly soluble Chloride; with I, insoluble *IODIDE, and various other salts, which are generally colourless.

Tests. HS, gives a black; KI, and KO₂CrO₃, a yellow; SO₃, or a soluble sulphate, a white precipitate.

Med. Effects. The salts of lead are sedative and astringent.

Incompatibles. S, Cl, I, SO₃, CO₂, CrO₃, T̄, and their soluble compounds—metallic zinc, vegetable astringents. The alkalies are incompatible with the salts of lead generally.

Toxicol. Effects. In large doses, or small ones long continued, poisonous. In acute poisoning, the symptoms and *post-mortem* appearances are those due to irritant poisons. In chronic poisoning, as from the vapour of lead in type foundries, handling of types, working in white lead, &c., the symptoms are those of Colica Pictorum, or lead palsy; which will be found treated of in works on the Practice of Medicine. Clean, new lead, is acted on by water containing CO₂, or by pure water; a very small quantity of earthy impurities prevents this; 5000 of sulphate of lime is sufficient. When lead pipe is used for conveying water, it may be protected by passing a soluble alkaline sulphate, or dilute, SO₃, through it, before bringing it into use.

A. OXIDE.

Offi. Prep. a. *PLUMBI OXIDUM SEMIVITREUM—
Semivitrified Oxide of Lead, Litharge, PbO.

Prep. Is made, on the large scale, by exposing melted lead to a current of air.

Prop. Small, brilliant, red or yellow vitrified scales, fusing at red heat. Slightly soluble in water; *saponifies* with oils. Absorbs, CO_2 , by exposure to the air. Is readily dissolved in dilute, NO_5 . Is largely employed in the arts, in painting, &c. Is not used as medicine, but enters into other officinal compounds, as (*a*) *EMP. PLUMBI, *lead plaster*; which is made by boiling together Litharge (lbv), Olive Oil (Cong. j), and Water (Oij).

B. NITRATE.

b. *PLUMBI NITRAS—Nitrate of Lead.

Prep. Is made by dissolving Litharge in dilute, NO_5 ; when crystallized, is in the form of white, nearly opaque crystals; soluble in water, and alcohol; and having a sweetish, astringent taste.

Uses. Is never used internally; rarely externally. It is employed as a *disinfectant*. Ledoyan's Disinfecting Solution, contains $\frac{3}{2}$ j to $\frac{3}{2}$ j water. It acts by absorbing HS, giving rise to PbS .

C. CARBONATE.

c. *PLUMBI CARBONAS—*Carbonate of Lead*. White Lead, PbO,CO_2 or $2(\text{PbO},\text{CO}_2) + \text{PbO},\text{HO}$.

Prep. Is prepared, on the large scale, by exposing metallic lead to the action of vapour of vinegar. A

subacetate is formed, which becomes carbonate by absorption of CO_2 , from the atmosphere, liberating the acetic acid, which acts on a fresh portion of metallic lead.

Prop. Fine, white, heavy, opaque, inodorous, nearly tasteless, insoluble powder. Dissolves freely in acids, with evolution of CO_2 .

Med. Effects. The most poisonous of the lead salt. Cases of acute poisoning are rare. The alkaline sulphates, generally employed as antidotes, are of little use; dilute, SO_3 , or Acid. Sulph. Arom., with emetics and purgatives, should be used. It is the salt which most commonly causes Colica Pictonum. It is used only externally, as a sedative and astringent.

*d. *UNGENTUM PLUMBI CARBONATIS—Ointment of the Carbonate of Lead.*

Prep. Is made by rubbing up ($\frac{3}{ij}$) *Plumb. Carb.*, and *Ung. Simp.* ($\frac{1}{bj}$); first softening the latter by heat.

D. IODIDE.

*e. *PLUMBI IODIDUM—Iodide of Lead.*

Prep. Is made by mixing solutions of Nitrate of Lead ($\frac{3}{iv}$ to Ojss *Aq. destill.*), and *Iodide of Potassium* ($\frac{3}{iv}$ to Oss *AQ. DESTILL.*); soluble Nitrate of Potassa, and Iodide of Lead, which precipitates, result. PbO , NO_5 , and $\text{KI} = \text{PbI}$ and KO, NO_5 .

Prop. Bright yellow, heavy, tasteless, inodorous powder; soluble in 1235 parts cold, and 194 boiling water.

The boiling solution is colourless, and deposits it, on cooling, in brilliant yellow scales. It melts, is volatilized, and finally decomposed by heat.

Med. Effects. Used only externally, in ointment, as an alterative, sedative, and astringent.

E. ACETATES.

*f. *PLUMBI ACETAS—Acetate of Lead.* Sugar of Lead.

Prep. Is prepared, on the large scale, by the action of Acetic Acid on lead plates frequently exposed to the air, or by dissolving litharge in the acid. The formula of the crystallized salt, is $\text{PbO}_2 \bar{A} + 3\text{HO}$.

Prop. White, crystalline, solid; sweetish, astringent taste; slightly efflorescent. Soluble in $1\frac{1}{2}$ parts cold water; the solution is turbid, on account of the formation of Carbonate, from the presence of Carbonic Acid in ordinary water.

Med. Effects. Astringent, and sedative; in large doses poisonous, but fatal results are very rare. Antidotes, alkaline sulphates, or dilute SO_3 . Dose, gr. v to 3j. Long continued, it may produce chronic poisoning.

Incompat. Acids, their carbonates, the soluble sulphates, chlorides, tartrates, and iodides, the vegetable astringents.

*g. *LIQUOR PLUMBI SUBACETATIS—Solution of the Subacetate of Lead.* Goulard's Extract.

Prep. Is made, by boiling together, *Plumbi Acetat.* (3xvj); *Plumb. Oxid. Semivit., Pulv. Subtil.* (3ixss),

and *Aq. Destill.* (Oiv), for half an hour; adding water, to keep up the quantity, and filtering. The Sp. Gr. of the solution is 1.267.

In this case, an additional quantity of PbO, is given to the acetate, forming $3\text{PbO},\overline{\text{A}}$ (trisacetate), or $2\text{PbO},\text{A}$ (diacetate). The liquid has a sweetish, astringent taste, and absorbs, CO₂, with great avidity, becoming turbid; hence should be kept in well-stopped bottles.

Med. Effects. Only used externally; is more poisonous than the acetate. Antidotes the same.

*h. *LIQUOR PLUMBI SUBACETATIS DILUTUS—Lead Water.*

Prep. Is made by diluting the last preparation, f 3ij to Oj. It is turbid, when first made; but if kept well-stopped, becomes clear, by the subsidence of the Carbonate.

*k. *CERATUM PLUMBI SUBACETATIS—Cerate of the Subacetate of Lead—Goulard's Cerate.*

R. 1. *Liq. Plumb. Subacetat.* f 3iiiss; 2. *Ceræ Albæ,* 3iv; 3. *Olei Olivi* f 3ix; 4. *Camphoræ* 3ss; mix 2, previously melted, with f 3viii 3, remove from the fire, and add 1, stirring constantly with a wooden spatula until cool, then add 4, dissolved in f 3j 3, and mix.

Rem. Soon becomes rancid.

XXIX. COPPER. Cu. 31.66.

Nat. Sources. Native, as Oxide, Sulphide, and Salt; is said to exist in the liver and blood.

Prop. Brilliant, sonorous, very malleable, and ductile metal, of a characteristic colour, slightly nauseous taste, and disagreeable odour when rubbed ; Sp. Gr. 8.89 ; fuses at 1996°.

Chem. Rel. Forms four oxides : Suboxide, Cu_2O , *Protoxide*, CuO , *Binoxide*, CuO_2 , and an undetermined higher oxide, which is acid ; the Protoxide forms an important series of salts ; the salts of Cu_2O are colourless, those of CuO of a rich blue or green colour.

Tests. Ammonia throws down a blue precipitate, soluble in excess, Ferrocyanide a brown, and Hydrosulphuric Acid a black precipitate.

Officinal Preparations.

A. SULPHATE.

a. ***CUPRI SULPHAS**—*Sulphate of Copper*—Blue Vitriol.

Prep. May be obtained by boiling Cu in HO_2SO_3 : SO_2 is given off ; $\text{Cu} + 2\text{SO}_3 = \text{CuO}_2\text{SO}_3$ and SO_2 ; is obtained, on the large scale, by roasting the native sulphide.

Prop. Rich, deep blue crystals ; nauseous styptic taste ; soluble in 4 parts cold, and 2 boiling water ; heated, undergoes aqueous fusion, then dries, and becomes white ; at a high temperature, is decomposed.

Med. Effects. Small doses, tonic, antispasmodic, and astringent ; large doses, emetic ; externally, escharotic, and in solution, astringent.

Toxicological Effects. In large doses, 3ss and more, an irritant poison, but not likely to be taken, on account of its taste. Antidotes: Magnesia, Albumen; the same may be said of all the Salts of Copper. The *Arsenite*, Scheele's Green, CuO_2AsO_3 , combines the effects of its constituents. When copper vessels are used in preparing food, or when workmen are exposed to it, slow poisoning may also take place, giving rise to cramps, vomiting, diarrhoea, and dysentery.

Incompat. Those of SO_3 ; Metallic Iron and Zinc; Ammonia.

B. ORGANIC COMPOUNDS.

b. CUPRI SUBACETATIS—*Subacetate of Copper*—Verdigris; impure Subacetate of Copper.

Prep. Is made by stratifying sheets of Copper and refuse of Grapes; the Alcohol in the husks becomes Acetic Acid, and unites with Oxide of Copper formed upon the plate. Its composition is variable; contains $3\text{CuO}_2\overline{\text{A}} + 6\text{HO}$, and $3\text{CuO}\overline{\text{A}} + 3\text{HO}$.

Prop. Pale, green-coloured, or blue masses, composed of silky needles; soluble in Ammonia, insoluble in Alcohol, and decomposed by water into neutral Acetate and Trisacetate.

Med. Effects. Used only externally as an escharotic and astringent; internally, like the other salts of copper, poisonous.

*c. *UNGUENTUM CUPRI SUBACETATIS*—Ointment of

Subacetate of Copper, is made by adding (3j) *Cup. Subacet.* to (3xv) *Ung. Simp.*, previously melted, and stirring until cold.

*d. *CUPRUM AMMONIATUM—Ammoniated Copper.*

Prep. Is made by rubbing (3ss) *Cupri Sulph.* with (3vi) *Ammon. Carb.*, until effervescence ceases.

Rem. The composition of this compound is not understood ; probably a *Cupro-Sulphate of Ammonia*, NH_4O , $\text{SO}_3 + \text{NH}_4\text{O}, \text{CuO} + \text{HO}$, in which the Oxide of Copper acts the part of an acid.

Prop. Beautiful deep azure-blue salt, with a strong ammoniacal odour, and styptic, metallic taste ; is freely soluble in water ; rapidly decomposes on exposure to the air.

Med. Effects. Tonic and antispasmodic.

Incompat. All Acids ; the Alkalies and Earths generally.

XXX. ZINC. Zn. 32.52.

Obtained from native Sulphide (blende) and Carbonate (calamine), by roasting, and reduction with C.

Prop. Bluish-white, soft, laminated metal ; peculiar taste and odour when rubbed ; when pure, may be rolled into sheets cold ; melts at 773° , at red heat boils and may be distilled ; takes fire in the air, with emission of white fumes of Oxide, ZnO ; dissolves in most acids, with evolution of H.

Chem. Rel. Forms, with O, two oxides, Protoxide ZnO, and Peroxide? The Protoxide gives a large number of salts, which are colourless; the Oxide, Carbonate, Sulphate, Chloride, and Acetate are officinal.

Med. Effects. The Salts of Zinc are tonic, antispasmodic, and astringent; they are poisonous, but not actively so; workmen engaged about them are liable to a *Zinc colic*.

A. OXIDE.

Officinal Preparations.

a. **ZINCI OXIDUM*—Oxide of Zinc. ZnO.

Prep. Is made by strongly heating the *CARBONATE.

Prop. Inodorous, tasteless, white powder; insoluble in Water and Alcohol, freely so in Acids; becomes yellow when moderately heated, but white again on cooling; at a low white heat, fuses, and at full white, sublimes. It is the *Zinc white* of commerce.

Med. Effects. Tonic, antispasmodic. Dose, gr. ij to x. Externally as mild astringent.

b. **UNGUENTUM ZINCI OXIDI*—*Ointment of Oxide of Zinc*, is made by rubbing f $\frac{3}{4}$ j ZnO with $\frac{3}{4}$ vi *Adipis*.

B. CARBONATES.

c. **CALAMINA*—*Calamine*—impure native Carbonate of Zinc. ZnO, CO₂.

Is generally very impure, many specimens containing no Carbonate of Zinc.

d. **CALAMINA PRÆPARATA*—*Prepared Calamine* (native Carbonate of Zinc.)

Prep. Is made by heating the Calamine to redness, and levigating and clutriating, as directed for *PREPARED CHALK.

Prop. A pinkish or flesh-coloured powder, of an earthy appearance.

Med. Effects. Used only externally; a mild astringent.

e. **CERATUM CALAMINÆ*—*Cerate of Calamine*—Turner's Cerate.

Prep. Is made by melting together *Cera Flav.* (3ij) and *Adeps* (lbj), and when, on cooling, they begin to thicken, stirring in *Calamina Prep.* (3ij).

f. **ZINCI CARBONAS PRÆCIPITATUS*—*Precipitated Carbonate of Zinc.*

Prep. Is made by mixing boiling solutions of Sulphate of Zinc and Carbonate of Soda; Sulphate of Soda remains in solution, and Carbonate of Zinc precipitates. It is a basic compound. Its formula is $8\text{ZnO}_3\text{CO}_2 + 6\text{HO}$.

Prop. A very soft white powder, resembling Magnesia Alba, freely soluble in HO_3SO_4 , with effervescence. Is used as a substitute for Calamine, which is often too impure for use.

g. **CERATUM ZINCI CARBONATIS*—*Cerate of the Carbonate of Zinc.*

Prep. Is made by rubbing up 3ij of the Carbonate with 3x *Ung. Simp.*

C. SULPHATE.

h. ZINCI SULPHAS—*Sulphate of Zinc*—White Vitriol.

Prep. Is made by dissolving Zn in $\text{H}_2\text{O}_2\text{SO}_4$; Zn and $\text{H}_2\text{O}_2\text{SO}_4 = \text{ZnO}_2\text{SO}_4$ and H.

Prop. Colourless, transparent salt, much resembling Epsom Salt, containing, when crystallized, 7 eq. HO; soluble in $2\frac{1}{2}$ parts cold, and less than its weight of boiling water; taste styptic, astringent; heated, undergoes aqueous fusion, becomes anhydrous, and finally loses its acid.

Med. Effects. Small doses, gr. j to ij, tonic, astringent, antispasmodic; large, $3j$, emetic; overdose, an irritant poison, rarely fatal, from its producing vomiting; its effects are combated by Mucilage and Albumen. Externally, as an astringent.

Incompat. The Alkalies and Earths, their Carbonates; Lead Salts; Vegetable Astringents.

D. CHLORIDE.

*i. *ZINCI CHLORIDUM*—*Chloride of Zinc*—Butter of Zinc.

Prep. Is made by dissolving Zinc ($3ijss$) in Acid. Muriatic, q. s., adding Acid. Nitric. ($f3j$), evaporating to dryness, then dissolving the dry mass in water, and adding ($3j$) *Creta prep.*, allowing the mixture to stand 24 hours, and again evaporating to dryness. The object of the addition of the Nitric Acid is to sesquioxidize any iron which may exist, and which is left behind when the dry mass is

redissolved. The addition of the chalk is for the same purpose.

Prop. Grayish-white, waxy, translucent, deliquescent solid.

Med. Effects. Used principally as an escharotic ; in large doses, a corrosive poison. Antidotes : the Alkaline Carbonates, Soap.

The *Liquor Zinci Chloridi* of the Dublin Ph., contains 175 grains to f $\frac{3}{4}$ j *Aqua* ; Burnett's Disinfecting Fluid contains 200 gr. to f $\frac{3}{4}$ j. Used diluted as an astringent and detergent wash.

E. ACETATES.

k. *ZINCI ACETAS—*Acetate of Zinc.*

Prep. Is made by agitating granulated Zinc ($\frac{3}{4}$ ix) with a solution of Acetate of Lead (lbj to Oij) for 5 or 6 hours, until the solution gives no precipitate with KI ; the Zinc removes all the Acetic Acid from the Lead, and is dissolved ; the solution is filtered, acidulated with \bar{A} , and crystallized.

Prop. Colourless, efflorescent plates, containing 7 eq. water of crystallization ; freely soluble in water, less so in dilute Alcohol.

Med. Effects. Used externally as an astringent.

Incompat. Mineral Acids, Alkalies, Earths, the Carbonates, the Vegetable Astringents.

NOBLE METALS.

XXXI. *MERCURY (HYDRARGYRUM). Hg = 200.*

Nat. Sources. Is found native, and obtained from its Bisulphide (Cinnabar), by distillation with lime or iron.

Prop. Pure Mercury is a brilliant, silvery liquid; tasteless, inodorous; Sp. Gr. 13.5. Does not change, by exposure to the air, at common temperatures. Heated to near the boiling-point, absorbs oxygen, becoming binoxide (HgO_2), which it yields at a higher heat, becoming again reduced. It boils at 662° , and may be distilled; freezes at -39° into a solid, resembling lead. Ordinarily it is contaminated with other metals (lead, bismuth, tin); these may be suspected by its tarnishing, and its globules having "tails." It may be purified by distillation, or by the action of dilute NO_5 , or Corrosive Sublimate.

Chem. Rel. Forms two oxides, HgO , Protoxide (Grey, or Black Oxide), and HgO_2 , Binoxide (Red Oxide, Red Precipitate); two sulphides, HgS , Protosulphide (Black Sulphide, Æthiops Mineral), HgS_2 , Bisulphide (Cinnabar); two chlorides, $HgCl$, Protochloride (Calomel), $HgCl_2$, Bichloride (Corrosive Sublimate); two Iodides, HgI , Prot-

* The equivalent of Mercury, is latterly assumed to be 100. This will alter the nomenclature of its compounds; Protoxide, HgO , will become Suboxide, Hg_2O , and so on. It has been deemed best to retain the former number in this connection.

iodide (Yellow Iodide), HgI_2 , Biniodide (Red Iodide). With the acids, a series of salts are formed with the two oxides of mercury, of which those of the binoxide are the most stable. The Metal, its Oxides, Nitrate, Sulphides, Sub-sulphate, Chlorides, Iodides, and Bicyanide, and Ammoniated Mercury, are officinal in various forms.

Med. Effects. Vary exceedingly with the dose, preparation, and mode of administration. See works on General Therapeutics.

Tests. See CORROSIVE SUBLIMATE.

A. AS METAL.

Off. Prep. a. *HYDRARGYRUM—*Mercury*.

b. *PILULÆ HYDRARGYRI—*Pills of Mercury—Blue Pills*.

Prep. Are made by rubbing $\frac{3}{j}$ *Hydrarg.* with $\frac{3}{ss}$ *Confect. Rosæ*, until the globules disappear, then adding $\frac{3}{ss}$ *Pulv. Glycyrrhizæ*, and dividing the mass into 480 (3 gr.) pills. It should contain $33\frac{1}{2}$ per cent. of mercury, or one gr. to each pill, but usually has less. It is generally made on the large scale. Dose, one to two pills.

c. *UNGUENTUM HYDRARGYRI—*Mercurial Ointment. Blue Ointment.*

Prep. R. *Hydrarg.* libij, *Adipis* $\frac{3}{xxij}$, *Sævi* $\frac{3}{j}$. Rub the Mercury with the Suet, and a portion of the Lard, until all the globules are extinguished; then add the remainder of the Lard. This preparation is also made on

the large scale. Various expedients have been proposed to facilitate the extinction of the metal, but they are not to be recommended. If long kept in jars, the metal settles, and the strength becomes unequal ; it should, therefore, be stirred from time to time. Used externally only.

*d. *EMPLASTRUM HYDRARGYRI—Mercurial Plaster.*

Prep. Is made by rubbing *Hydrarg.* ($\frac{3}{2}$ vi) with equal parts ($\frac{3}{2}$ iiij) of *Ol. Olivæ*, and *Resinæ*, previously melted together and cooled, until the globules disappear, and adding these to (libj) *Emp. Plumbi*, previously melted, and mixing. Mercury is also employed in the **Emplast. Ammoniaci cum Hydrargyro.*

*e. *HYDRARGYRUM CUM CRETA—Mercury with Chalk.*

Prep. Is made by rubbing ($\frac{3}{2}$ iiij) *Hydrarg.* with ($\frac{3}{2}$ v) *Cretæ Preparatæ*, until the globules disappear. It combines the antacid effects of the Chalk, with the alterative powers of the Mercury. There is too little chalk to be of much service ; more may be added at the time of prescribing.

Dose, gr. v to $\frac{3}{2}$ ss. The Dublin Ph. has a corresponding preparation, made with Magnesia—*Hydrargyrum cum Magnesiâ.*

B. OXIDE.

*f. *HYDRARGYRI OXIDUM NIGRUM—Black Oxide of Mercury (protoxide). HgO.*

Prep. Is made by adding Calomel ($\frac{3}{2}$ iv) to a solution

of Caustic Potassa ($\frac{3}{4}$ iv to Oj Aq.); $HgCl$, and $KO = HgO$, and KCl . The precipitate of HgO is washed, and dried at a gentle heat.

Prop. A greenish-black powder, becoming olive after a time, inodorous, tasteless; insoluble, except in acids. Decomposed by light, and low heat, into a mixture of Hg , and HgO_2 ; by high heat, into Hg , and O ; resembles Calomel in its action; dose, gr. $\frac{1}{4}$ to gr. iiij. The *Black Wash*, made by adding 3j of Calomel to Oj Lime-water, contains this oxide.

*g. *HYDRARGYRI OXIDUM RUBRUM—Red Oxide of Mercury, Binoxide, Red Precipitate.*

Prep. Is made by heating the Nitrate, which contains HgO_2 , $2NO_5$, and HgO , NO_5 . The NO_5 is decomposed, NO_2 is given off, and $2O$ go to oxidize the Protoxide to Binoxide, which remains. It may also be made by exposing the metal at, or near its boiling-point, to the air (Red Precipitate *per se*, Calcined Mercury). Also by adding a caustic alkali, to a solution of corrosive sublimate, a *yellow* precipitate falls (Yellow Wash); which is probably a hydrate, $HgCl_2$, and KO , $3HO = HgO_2 \cdot 3HO$, and KCl . The first is the officinal process.

Prop. Bright, orange-red powder; slightly soluble in water; decomposed by high heat into Hg , and O . It is not used internally; externally, is stimulant, and escharotic.

*h. *UNGMENTUM HYDRARGYRI OXIDI RUBRI—Oint-*

ment of the Red Oxide of Mercury. Red Precipitate Ointment. Is made by rubbing up ʒj of Red Precipitate, in fine powder, with ʒj Simple Ointment.

c. NITRATE.

i. **UNGUENTUM HYDRARGYRI NITRATIS—Ointment of the Nitrate of Mercury.* Citrine Ointment.

Prep. Is prepared by adding Nitrate of Mercury to a mixture of fresh Neats-foot oil (fʒix), and Lard (ʒiii). The nitrate is prepared by dissolving (ʒj) Hg, in (fʒiv) HO₂NO₅. The nitrate is reduced by the mixture, to sub-nitrate of the deutoxide; and other changes, not well understood, take place. The ointment is a bright yellow colour, when first made; soon changes, becoming greenish, mottled, and more or less brittle.

The *Hydrargyri Pernitratis Liquor* of the Dub. Ph., solution of the Acid Nitrate of Mercury, much used as a caustic, is made by dissolving ʒj, avoirdupois, Hg, in fʒiss NO₅, diluted with fʒiss *Aqua*. It is a solution of the Nitrate of the Deutoxide HgO₂2NO₅, with an excess of acid.

d. SULPHIDES.

k. **HYDRARGYRI SULPHURETUM NIGRUM—Black Sulphuret (Sulphide) of Mercury.* Æthiops Mineral.

Prep. Is made by rubbing together equal parts of sulphur and mercury. Is uncertain in composition. HgS, or HgS₂, and S.

Prop. Heavy, tasteless, insoluble, black powder; becoming violet, and decomposed by heat. Is very little used. Dose, gr. v to 3j.

*t. *HYDRARGYRI SULPHURETUM RUBRUM—Red Sulphuret (Sulphide) of Mercury.* Cinnabar, Vermilion, Hg_2S_2 .

Prep. Is made by heating together ($\frac{3}{2}$ xl) Mercury, and ($\frac{3}{2}$ vii) Sulphur. Is made generally on the large scale.

Prop. Heavy, brilliant red, crystalline masses; inodorous; insoluble. Is volatilized and decomposed by heat. Is used only for fumigations.

E. SULPHATE.

*m. *HYDRARGYRI SULPHAS FLAVUS—Yellow Sulphate of Mercury.* Turpeth Mineral.

Prep. Is made by throwing the Sulphate of the Deutoxide ($\text{HgO}_2 \cdot 2\text{SO}_3$) (see Calomel, Corrosive Sublimate), into water. It is decomposed into Turpeth Mineral, $3\text{HgO}_2 \cdot 2\text{SO}_3$, and Supersulphate of Mercury, $\text{HgO}_2 \cdot 6\text{SO}_3$.

Prop. A lemon-yellow powder, of an acrid taste. Dose, as alterative, gr. $\frac{1}{4}$ to $\frac{1}{2}$; emetic, gr. iij to v. Used also as an errhine.

In overdose, an irritant poison. Antidote: Albumen?

F. CHLORIDES.

*n. *HYDRARGYRI CHLORIDUM MITE—Mild Chloride of Mercury—Protocloride, Calomel.*

*o. *HYDRARGYRI CHLORIDUM CORROSIVUM—Corrosive Chloride of Mercury—Bichloride, Corrosive Sublimate.*

As the processes for preparing them are intimately connected, they will be described together.

1. *Corrosive Sublimate* is made as follows: Sulphate of the Deutoxide of Mercury is made by boiling (lbii) Hg in (lbiii) Sulphuric Acid, Sulphurous Acid being liberated, $\text{Hg} + 4\text{SO}_3 = \text{HgO}_2, 2\text{SO}_3$ and 2SO_2 .

This is rubbed, when cold, with (lbiss) common Salt, and the mixture sublimed. The Corrosive Sublimate sublimes, and Sulphate of Soda remains. $\text{HgO}_2, 2\text{SO}_3$ and $2\text{NaCl} = \text{HgCl}_2$ and $2\text{NaO}, \text{SO}_3$.

2. Calomel is made as follows: the Sulphate of the Deutoxide of Mercury is made as before; this is rubbed with another equivalent of Mercury (lbij), and reduced to the Sulphate of the Protoxide, $\text{HgO}_2, 2\text{SO}_3 + \text{Hg} = 2(\text{HgO}, \text{SO}_3)$; this is sublimed with the same quantity of Chloride of Sodium as the last (lbiss), $2\text{HgO}, \text{SO}_3$ and $2\text{NaCl} = 2\text{HgCl}$ and $2(\text{NaO}, \text{SO}_3)$. The Calomel is washed, to free it from any Corrosive Sublimate, until the washings no longer give a precipitate with Ammonia.

CALOMEL, in mass, is a white, fibrous, crystalline substance, giving a yellow streak when scratched. Sp. Gr. 7.2. Becomes yellow and blackish, on exposure to light. Is insoluble in Water, Alcohol, and Aether, but volatile; should be entirely volatilized by heat. Its medicinal pro-

perties are too various to be described here. Dose, gr. $\frac{1}{20}$ to $\frac{3}{5}$ i; the *o *PILULEÆ HYDRARGYRI CHLORIDI MITE*, Calomel Pills, contain 1 gr. each, mixed with Gum Arabic and Syrup.

Incompatibles. The Alkalies, Alkaline Earths, their Carbonates, Soap, SULPHIDES, Hydrocyanic Acid, Common Salt? Iron? Lead? Copper?

p. CORROSIVE SUBLIMATE.

Prop. Colourless, transparent crystals, or white, semi-transparent, crystalline masses; Sp. Gr. 5.2; permanent in the air; inodorous, acrid, persistent, metallic taste; melts and volatilizes readily, with dense, acrid fumes; soluble in 20 parts cold, and 3 boiling water, in Alcohol, and *AEther*; also, without change, in Sulphuric, Muriatic, and Nitric Acids; Muriate of Ammonia, and common Salt, render it more soluble in water. It retards putrefaction, by coagulating albumen and fibrin. Should dissolve wholly in *AEther*, and be wholly volatilized by heat. Dose, gr. $\frac{1}{12}$ to $\frac{1}{16}$.

Incompat. Alkalies, Alkaline Earths, their Carbonates, Soap, Iodides, Sulphides, Tartar Emetic, Nitrate of Silver, Acetates of Lead, and many Metals, Vegetable Astringents, Albumen, Fibrin, Gluten.

Toxicological Effects. In overdose, gr. iii to v., a corrosive poison; recovery has taken place, after an ounce had been swallowed. Antidotes: Albumen (white of egg,

blood), Fibrin, Gluten (flour), Milk, with free evacuation of the stomach.

Tests. 1. Lime-water, *yellow* Hydrate of Deutoxide, $\text{HgO}_2 \cdot 3\text{HO}$.

2. Carbonate of Potassa, *brick red* Carbonate of Mercury, $\text{HgO} \cdot \text{CO}_2$.

3. Iodide of Potassium, *scarlet* Biniodide of Mercury, HgI_2 .

4. Ammonia, *white* Amide of Chloride of Mercury ? $\text{HgCl}_2 \cdot \text{NH}_2$.

5. Hydrosulphuric Acid, *black* Sulphide of Mercury, HgS .

6. Protochloride of Tin, *greyish-black* Sulphide of Mercury, Hg .

7. A bright plate of Copper, immersed in solution, reduces the metal.

8. Gold, in a solution of mercury, touched with Iron or Zinc, causes reduction of the metal; the metal may be sublimed from the precipitates by heat. The relative delicacy of these tests is thus given : Lime-water, 4; $\text{KO}_2 \cdot \text{CO}_2$, 7; KI, 8; NH_4O , 36; HS, 60; SnCl, 80; the last two are still more delicate, and act in the presence of organic matter.

G. IODIDES.

g. *HYDRARGYRI IODIDUM—*Iodide of Mercury*—Yellow Iodide, Protiodide, HgI .

Prep. Is made by rubbing together, with the aid of a little Alcohol ($\frac{3}{j}$), *Hydrurg.* and ($\frac{3}{v}$) *Iodine*.

Prop. A yellowish-green powder, becoming darkened by exposure to light; insoluble in Water and Alcohol, soluble in \mathcal{A} ether; Sp. Gr. 7.75; volatilized by heat, condensing in red crystals, which become yellow; is mild in its alterative action. Dose, gr. i to iii. Iodide of Potassium converts it into HgI_2 .

r. *HYDRARGYRI IODIDUM RUBRUM—Red Iodide of Mercury, Biniodide, HgI_2 .

Prep. Is made by mixing solutions of Corrosive Sublimate ($\frac{3}{i}$ to Oiss *Aq.*) and Iodide of Potassium ($\frac{3}{x}$ to Oss); Biniodide of Mercury precipitates, and Chloride of Potassium remains in solution, $HgCl_2$, and $2KI = HgI_2$, and $2KCl$. May also be made, by rubbing together one eq. Mercury with two eq. Iodine.

Prop. Brilliant scarlet powder; Sp. Gr. 6.3; insoluble in water, soluble in alcohol, in solutions of KI, and NaCl; is dimorphous; heated, becomes yellow, and sublimes in yellow crystals; when yellow, becomes red again by pressure. Dose, gr. $\frac{1}{15}$. Resembles in its effects Corrosive Sublimate. In overdose, an irritant poison. Antidotes, as in Corrosive Sublimate.

s. *LIQUOR ARSENICI ET HYDRARGYRI IODIDI—*Solution of the Iodides of Arsenic and Mercury—Donovan's Solution.*

Prep. Is made by rubbing equal parts, gr. xxv, of

*IODIDE OF ARSENIC, and red Iodide of Mercury together, with fīss of Water, adding fīviiss Water, heating to the boiling-point, and filtering.

Prop. A pale yellow solution; incompatible with *Tr. Opii* and Salts of Morphia. Dose gtt. v to xx.

H. CYANIDE.

t. *HYDRARGYRI CYANURETUM—*Cyanuret of Mercury*—Bicyanide, HgCy_2 .

Prep. Is made by boiling together *Prussian Blue* and red Oxide of Mercury, 2FeCy_6 and $9\text{HgO}_2 = 9\text{HgCy}_2$ and 6FeO , and $4\text{Fe}_2\text{O}_3$.

Prop. Transparent, or opaque white crystals, of a disagreeable styptic taste; freely soluble in cold water; HCl liberates Hydrocyanic Acid. In large doses, is a potent poison; no direct antidote is known; those for HgCl_2 may be used. Dose, gr. $\frac{1}{16}$ to gr. $\frac{1}{8}$.

u. *HYDRARGYRUM AMMONIATUM—*Ammoniated Mercury*—White Precipitate.

Prep. Is made by adding Ammonia to a solution of Corrosive Sublimate; White Precipitate is thrown down, and Chloride of Ammonium remains. It is believed to be a compound of Amide (NH_2), with Chloride of Mercury, $2\text{NH}_4\text{O}$ and $\text{HgCl}_2 = \text{NH}_4\text{Cl}$, and 2HO , and $2\text{HgCl}_2\text{NH}_2$.

Prop. White powder, of an earthy, metallic taste; insoluble in alcohol and cold water; decomposed by boiling water; exposed to strong heat, dissipates, being decom-

posed into N, NH₄O, and HgCl. It is only used externally.

v. *UNGUENTUM HYDRARGYRI AMMONIATI—Ointment of Ammoniated Mercury—White Precipitate Ointment.

Prep. Is made by rubbing 3*i* of White Precipitate with 3*iss* *Ung. Simp.*

XXXII. *SILVER (ARGENTUM). Ag. 108.

Nat. Sources. Found native, as Sulphide, Chloride (Horn Silver), and Bromide.

Prop. Perfectly white, highly lustrous metal, very good conductor of heat and electricity; Sp. Gr. 10.5; tenacious, malleable, and ductile; melts at a bright red heat; does not oxidize at any temperature, but becomes covered with a black tarnish of Sulphide, in presence of compounds of S.

Chem. Rel. Forms with O, Suboxide, Ag₂O?; Prot-oxide, AgO, and Peroxide?; with S, Sulphide, AgS; with Cl insoluble, AgCl, white, blackening on exposure to the light. Its Iodides and Bromides also change thus, and are hence used in photography. It dissolves freely in cold NO₅. Its Oxide, Nitrate, and Cyanide are officinal.

Test. The soluble Chlorides give with the Salts of Silver a white, curdy precipitate (AgCl), blackening on exposure to the light, and insoluble in boiling Nitric Acid.

The metal is reduced from its solution by Iron, Copper, Mercury, and other metals.

Off. Forms. a. *ARGENTUM—*Silver.*

b. *ARGENTI OXIDUM—Oxide of Silver. AgO .

Prep. Is made by adding *LIQUOR POTASSÆ to a solution of Nitrate of Silver (f $\ddot{\Sigma}$ iv to Oss Aq. Destill.) as long as a precipitate falls; Nitrate of Potassa remains in solution, AgONO_5 and $\text{KO} = \text{AgO}$ and KO,NO_5 .

Prop. An olive-brown powder; should not effervesce with acids.

Med. Effects. Its effects, internally, are similar to those of Nitrate of Silver, over which it is supposed to have the advantage of not discolouring the skin.

c. *ARGENTI NITRAS—*Nitrate of Silver.* AgO,NO_5 .

Prep. Is made by dissolving Silver in Nitric Acid, 3 Ag and $4\text{ NO}_5 = 3(\text{AgO},\text{NO}_5)$ and NO_2 .

Prop. Colourless, transparent crystals of an intensely metallic and bitter taste; blackens on contact of organic matter; soluble in its weight of cold water and 4 parts boiling Alcohol.

Med. Effects. Various; internally tonic, antispasmodic; externally, sedative, escharotic, astringent; in overdose, a corrosive poison. Antidote, common Salt.

Test. See Silver.

Dose, gr. $\frac{1}{4}$, gradually increased.

Incompatibles. Muriatic, Sulphuric, Acetic Acids, and their soluble salts. The soluble Iodides, and Sulphides,

the Alkalies, Alkaline Earths, their Carbonates, Tartar Emetic, Corrosive Sublimate, Iron, Lead, Copper, Mercury, Vegetable Astringents.

*d. *ARGENTI NITRAS FUSUS—Fused Nitrate of Silver*
—Lunar Caustic—*Lapis Infernalis.*

Prop. Is made by melting the Nitrate and pouring it into moulds.

Prop. Is in the form of small sticks, which gradually blacken on exposure to light, probably from the presence of organic matter.

Med. Uses. Is intended solely for external use.

*c. *ARGENTI CYANURETUM—Cyanuret (Cyanide) of Silver.*

Prop. Is made by distilling Hydrocyanic Acid, from Ferrocyanide of Potassium and dilute SO_3 , into a solution of AgO,NO_5 . It may also be formed by adding Cyanide of Potassium, KCy , to a solution of AgONO_5 .

Prop. It is a tasteless, white, insoluble powder; soluble in boiling NO_5 .

Use. Is not used in medicine, but for the purpose of preparing *HYDROCYANIC ACID, extemporaneously by the addition of HCl .

XXXIII. GOLD (AURUM). Au. 98.33.

Nat. Sources. Occurs native.

Prop. Is a soft, yellow metal, the most malleable of the metals; is very ductile; Sp. Gr. 19.5; melts at a

bright red heat; is unaffected by ordinary oxidizing agents and the Acids; is dissolved by Nitromuriatic Acid.

Chem. Rel. Forms with O, Protoxide, AuO , Terxide (Auric Acid) AuO_3 , Perauric Acid, AuO_5 ?; with S, by indirect combination, Protosulphide, AuS , and Tersulphide, AuS_3 ; with Cl, Protochloride AuCl , and Terchloride, AuCl_3 ; and similar compounds with I.

Med. Uses. The preparations of Gold have been used in the treatment of syphilis. They are highly poisonous, and prone to decomposition.

XXXIV. PLATINUM. Pt.

Nat. Sources. Occurs native.

Prop. Is a white metal, very malleable and ductile, harder than Gold, fused only by the highest artificial heat; Sp. Gr. 21.5; is not affected by air, moisture, or ordinary acids; is soluble in Nitromuriatic Acid; is, from its unalterable character, largely used in the arts.

Chem. Rel. It forms two Oxides, PtO and PtO_2 , two Chlorides PtCl and PtCl_2 , and compounds with Iodine, Bromine, Sulphur, and Phosphorus. The Bichloride, PtCl_2 , made by dissolving the metal in Nitromuriatic Acid, is used as a test for Potassa, with which it combines to form a double salt, Bichloride of Platinum and Chloride of Potassium, $\text{PtCl}_2 + \text{KCl}$. Platinum *sponge* and *black* are the metal in a state of fine division. The Platinum compounds are not used in medicine.

PART III.

ORGANIC CHEMISTRY.

ORGANIC CHEMISTRY investigates the compounds produced under the influence of *vitality*, and those derivable from them by chemical means.

These substances present us with certain peculiarities.

1. The complex arrangement of the elements composing them.—Inorganic substances rarely contain over seven equivalents of any element entering into their composition. Organic substances have generally a large number. In Inorganic Compounds, the elements are arranged in *pairs*, forming *Binary*, *Ternary*, *Quaternary* compounds (see page 17). In Organic substances, no such division can in most cases be made. Ex.: Sulphate of Potassa, K_2SO_4 , consists of two *pairs* of elements, Quinia, $C_{20}H_{12}NO_2$, combines, and is separated from combination as a whole.

2. Organic substances, although containing, in most cases, many *equivalents* of their constituents, are made up of few *elements*. A large proportion contain only Carbon and Hydrogen, or Carbon, Hydrogen, and Oxygen,

a smaller class Nitrogen; while a few contain Sulphur and Phosphorus, and compounds may be artificially prepared into which other elements enter.

3. The elements entering into Organic Compounds are not arranged according to their strongest affinities. Hence, these compounds are readily decomposed, and the more so, as a general rule, in proportion to the number of their elements. When the decomposition is complete, Carbonic Acid from the union of the Carbon and Oxygen, Ammonia from that of the Nitrogen and Hydrogen, Water from that of the Hydrogen and Oxygen, and occasionally compounds of Sulphur and Phosphorus with Hydrogen result.

By acting upon organic substances with chemical agents, they are broken up and rendered less complex. We cannot, as a general rule, increase the number of elements or of equivalents. The rare exceptions to this law (Ex.: *urea*), assimilate to inorganic compounds.

4. There are cases in which a certain number of equivalents of an element or compound may be *substituted* for those of another, without, in most instances, altering essentially its physical characters; these are called substitution products, and afford an important exception to the rule last laid down. Thus, by acting upon cotton $C_{24}H_{20}O_{20}$, by strong Nitric Acid, Gun-cotton (*Pyroxylene*) is formed, in which five equivalents of Hydrogen are re-

placed by five of Hyponitric Acid, giving the formula,
 $C_{24} \left\{ \begin{matrix} H_{16} \\ 4 NO_4 \end{matrix} \right\} O_{20}$, or $C_{24}H_{16}N_4O_{36}$.

Organic bodies will be considered under the following heads.

1. STARCH GROUP. Comprising bodies composed of Carbon, Hydrogen, and Oxygen, which are neutral, or nearly so, and their derivatives.

2. QUASI-ELEMENTARY SUBSTANCES. Compounds which act the part of elements : 1. Those resembling, in their chemical relations, Hydrogen and the Metals (salt basyles), as Ethyl, Methyl, Amyl, &c., which form compounds with Oxygen, &c., and their Oxides with the Acids,—the Ethers ; 2. Those which resemble, in their chemical relations, Chlorine, Oxygen, &c. (salt radicals), as Cyanogen, which forms with Hydrogen, Hydrocyanic Acid, analogous to the Hydrochloric, and Cyanides, analogous to the Chlorides.

3. ORGANIC ACIDS, not Oxides of known radicals, and not otherwise classified, as the Tartaric, Citric, &c.

4. ORGANIC BASES, not Oxides of known radicals, and not otherwise classified. The Alkaloids, Quinia, Morphia, &c. They contain Nitrogen.

5. FATS and OILS.

6. COLOURING PRINCIPLES.

7. The ALBUMEN GROUP, comprising the chemistry of the animal fluids.

I. STARCH GROUP.

The most important members of this group are,—

1. *STARCH, $C_{24}H_{20}O_{20}$.
2. LIGNIN, $C_{24}H_{20}O_{20}$.
3. *GUM ARABIC, $C_{24}H_{22}O_{22}$.
4. *GUM TRAGACANTH, $C_{24}H_{20}O_{20}$.
5. *CANE SUGAR, $C_{24}H_{22}O_{22}$.
6. GRAPE SUGAR, $C_{24}H_{28}O_{28}$.

A. *STARCH.

Nat. Sources. Found abundantly in the vegetable kingdom, especially in the seeds and roots of plants.

Prep. Is obtained generally by rasping or crushing the vegetable, and washing the mass upon a sieve; the starch passes through, and settles at the bottom of the liquid.

Prop. It is a white, shining powder, exhibiting, under the microscope, irregular grains, consisting of layers covered by an external membrane; it is insoluble in cold water, but when boiled, the globules burst, and form a transparent jelly, *Amidin*, which gives a characteristic blue colour with free Iodine. Starch is officinal, as,

- a. *AMYLOM, Wheat Starch.
- b. *MARANTA, Arrow-Root, the fecula of the rhizoma of Maranta Arundinacea.
- c. *SAGO, the prepared fecula of the pith of Sagus Rumphii.

d. *TAPIOCA, the fecula of the root of *Jatropha Manihot*. The starch of an imperfectly determined species of *Canna*, *tous les mois*, is officinal in the Ed. Ph., and Potato Starch is often used as a substitute for Arrow-Root. By long boiling with dilute acids, by roasting, or by the action of *diastase*—a peculiar principle found in germinating seeds and buds—Starch is converted into a substance much resembling Gum, known as DEXTRINE (British Gum). By continuing the process, Dextrine is converted into Grape Sugar. Nitric Acid converts Starch into OXALIC ACID. (See Sugar.)

B. LIGNIN—*Cellulose*.

Nat. Sources. The fundamental material of the structure of plants; is identical in composition with Starch; has been found in certain diseased conditions of the human brain; is seen nearly pure in fine linen or cotton.

Prop. Is insoluble in ordinary menstrua, not nutritious, and is unaffected by dilute acids or alkalies; strong Oil of Vitriol, in the cold, converts it into *Dextrine*, and finally into *Grape Sugar*; it is not coloured by Iodine; by the action of strong Nitric Acid, it is converted into an explosive substance, a. PYROXYLINE, in which a portion of its Hydrogen is replaced by Hyponitric Acid. There appear to be two species, one of which is insoluble in \AA ether, and highly explosive, the other soluble, and less explosive; the latter is said to be formed, when cotton is

acted on by a mixture of concentrated Nitric Acid and Oil of Vitriol, at the temperature of their mixture; the former when cold. The exact composition of these has not been determined; they have been given as $C_{24} \left\{ \begin{matrix} H_{14} \\ 6 NO_4 \end{matrix} \right\} O_{20}$, or $C_{24}H_{14}N_6O_{44}$, for the soluble form, and the insoluble as $C_{24} \left\{ \begin{matrix} H_{16} \\ 4 NO_4 \end{matrix} \right\} O_{20} = C_{24}H_{16}N_4O_{36}$. The æthereal solution of the soluble pyroxyline is officinal, as *b. *COLLODIUM*; in the formula the cotton is steeped in a mixture of Nitre and Oil of Vitriol, by which Nitric Acid is generated.

Similar explosive compounds are formed by the action of Nitric Acid on Starch (xyloidine), Paper, Glucose, Mannite, Gum, and Dextrine.

Wood exposed to the air, undergoes slow decay, *cremation-causis*, due to the absorption of Oxygen: Carbonic Acid and Water are produced. Vegetable mould contains certain principles, which have been described as *humus*, *geinc*, *ulmin*, *humic* and *ulmic* acids: they usually contain Ammonia, the Nitrogen of which is supposed to be obtained from the atmosphere.

When vegetable fibre undergoes decomposition, excluded from the air, either under water or ground, it is converted into *peat*; and gradually into *lignite*, and *coal*.

By destructive distillation, a very large number of products, principally hydro-carbons, are obtained from wood and coal. Among the products of this distillation may be

mentioned, *Pyrolignous Acid*, which will be referred to under Acetic Acid, also,

c. *PIX LIQUIDA. *Tar*, which yields, on distillation, a number of volatile principles, and leaves a hard residue, *Pitch*.

d. KREASOTE, $C_{28}H_{16}O_4$ —*CREASOTUM. Obtained from Wood-tar, or crude Pyroligneous Acid.

Prop. It is, when pure, a colourless, oleaginous liquid; of a caustic, astringent taste; peculiar odour; is inflammable; boils at 397° . It is powerfully antiseptic; coagulates albumen. It is used externally as a styptic, stimulant, and antiseptic; internally, as an antiseptic, astringent, and to relieve nausea and vomiting. Is soluble in 80, or $\frac{1}{10}$ th, parts of water only; but may be rendered soluble in any proportion, by the addition of a few drops of acetic acid.

Dose, gtt. ss to j; in overdose, an irritant poison. Treatment, that for Corrosive Sublimate. Used externally in ointment.

e. *UNGUENTUM CREASOTI. Containing fʒss to ʒj of lard.

The other products of the destructive distillation of wood, or coal, are highly interesting, but their full discussion would be out of place in the present work. Some of them will be considered under other heads.

c. GUM, $C_{20}H_{22}O_{22}$.

a. GUM ARABIC—*ACACIA. Is the type of this class. The *mucilages* are identical in composition with it.

Prep. Gum is soluble in water; boiled with dilute Sulphuric Acid, is converted into Grape Sugar. Nitric Acid, produces *Mucic Acid*, $C_{12}H_{10}O_{18}$.

b. GUM TRAGACANTH, $C_{24}H_{20}O_{20}$ —*TRAGACANTHA. Is distinguished from ordinary gum, by refusing to dissolve in water; it merely swells up, forming a thick, viscous paste. It is composed chiefly of a peculiar mucilage, *Bassorin*.

D. SUGAR.

Several species of Sugar are distinguished.

a. Cane-Sugar, $C_{24}H_{22}O_{22}$ —*SACCHARUM.

Prep. Obtained principally from the juice of the *Saccharum officinarum*, or Sugar Cane; obtained also from the Sap of the Maple, the root of the Beet, &c.

Prop. It is in crystals, which, when pure (Rock Candy), are freely soluble in water, forming *Syrup*. At a moderate heat, it melts, forming on cooling, a transparent, amorphous mass (Barley Sugar). At a higher heat, it loses two equivalents of water, and becomes blackened (Caramel). By the action of Nitric Acid, it is converted into Oxalic Acid. This is due to the replacement of the whole of the hydrogen of the sugar, and an increase of its oxygen, by oxygen derived from the decomposition

of the Nitric Acid; Binoxide of Nitrogen being given off. 12NO_5 , and $\text{C}_{24}\text{H}_{22}\text{O}_{22} = 22\text{HO}$ and 12NO_2 and $\text{C}_{24}\text{O}_{36}$. $\text{C}_{24}\text{O}_{36} = 12(\text{C}_2\text{O}_3)$.

b. GRAPE SUGAR—Glucose, $\text{C}_{24}\text{H}_{28}\text{O}_{28}$. Exists in ripe fruits; previous to ripening, they contain starch.

Prop. It may also be formed by the action of Sulphuric Acid on sugar, starch, lignin, &c. Exists in the urine in diabetes.

Prop. Is less sweet than Cane Sugar, and less soluble, requiring one and a half parts of cold water for solution. It is somewhat soluble in Alcohol, hardly affected by the Mineral Acids, which destroy cane-sugar; but is destroyed by alkalies, with which cane sugar forms definite compounds.

Tests. 1. Trommer's. Add to the suspected solution (Diabetic Urine for instance), a few drops of solution of Sulphate of Copper, add an excess of Caustic Potassa; if Sugar be present, a deep-blue liquid results, which deposits on boiling, Red Suboxide of Copper. *Long* boiling must be avoided, as other organic substances then give the reaction. 2. Fermentation. A little Yeast will cause fermentation in Diabetic Urine; it often takes place spontaneously. 3. Horsley recommends the use of an alkaline solution of Bichromate of Potassa, mixed with the suspected solution. A deep, sap-green colour results, from the production of Sesquioxide of Chromium.

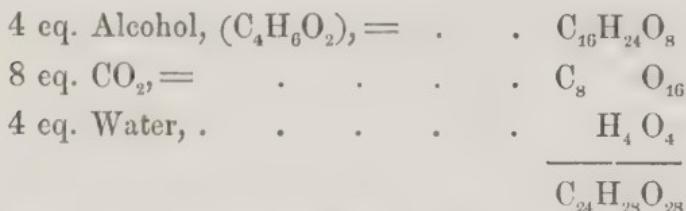
Other organic matters reduce Chromic Acid ; this test must, therefore, be cautiously employed.

HONEY—*MEL. Is a mixture of crystallizable Grape Sugar, with an uncrystallizable compound having the same composition. *Sugar of Milk*—*Lactin*, $C_{24}H_{24}O_{24}$, is obtained from the Whey of Milk. *Mannite*, $C_{12}H_{14}O_{12}$, found in abundance in **Manna*. *Glycyrrhizin*, found in **Glycyrrhiza*; and Sugar from **ERGOT*, $C_{24}H_{26}O_{26}$, are all varieties of Sugar, differing more or less from cane and grape sugar. GLYCOCOLL, Sugar of Gelatin, and *Inosite*, from flesh, are described in Group VII. A saccharine matter, resembling Glucose, is found in the liver.

FERMENTATION.

1. *Vinous*. When the juice of grapes, or other fruits containing Grape Sugar, is exposed to the air, a peculiar decomposition ensues ; the sugar being converted into Carbonic Acid Gas, which is given off, and **ALCOHOL*, which remains. Although air is necessary for the commencement of the process, it will go on without it when once begun. A solution of pure sugar is not changed by exposure to the air ; but if we add a little Yeast (*Dia-stase*), Blood, Albumen, Flour-paste (*Gluten*), or other nitrogenized substance, capable of undergoing putrefaction, this change is effected. This action is called Fermentation. Its exact nature is not understood ; but is supposed to be by the molecular change taking place in the

ferments, inducing a similar one in the particles of the solution with which they are in contact,—*decomposition by example*. Grape Sugar is the only variety capable of vinous fermentation; the other sugars being first converted into it before undergoing this process. The conversion of Grape Sugar into Alcohol and Carbonic Acid, is simple; one eq. of grape sugar, $C_{24}H_{28}O_{25}$, becoming 4 eq. Alcohol, 8 of CO_2 , and 4 of water.



By long exposure to the air, the Alcohol becomes oxidized into *ACETIC ACID. See ETHYL.

2. *Lactic*. By the action of casein (a nitrogenized principle, existing in Milk and Cheese) upon Sugar, *Lactic Acid*, $C_{12}H_{12}O_{12}$, is produced. It combines with bases to form Salts, of which the Lactate of the Protoxide of Iron and the Lactate of Quinia have been used as tonics.

3. *Butyric*. By a continuation of the above process Lactic Acid disappears, and *Butyric Acid*, $C_8H_8O_4$, is produced. This Acid is also found in rancid Butter, and sometimes in animal fluids.

4. *Viscous*. The Sugar of Beets or Carrots, exposed to a high temperature, undergoes a peculiar fermentation,—the viscous. Carbonic Acid and Hydrogen are given off, and traces of Alcohol, with Lactic Acid, Mannite, and

a gum, are left. This fermentation may be produced in ordinary Sugar by the admixture of Gluten and Yeast.

II. QUASI-ELEMENTARY BODIES.

These, although Compound, act the part chemically of Elementary substances.

1. Those which resemble Hydrogen and the Metals, combining with Oxygen, Chlorine, &c., and their Oxides, with Acids—Organic Salt Basyls. One of these, Ammonium, has been already considered, p. 99. Many of them are hypothetical, and of those which have been isolated, but one (Kakodyl) combines directly with the other elements to form its compounds. It must, therefore, be remembered that the compounds of these quasi-elements differ essentially from the *Salts*, which have been already considered.

2. Those which chemically resemble oxygen, sulphur, and the halogens; Organic Salt Radicals, Ex.: Cyanogen, p. 50.

Of the Organic Salt Basyls the following are among the most important:—

1. ETHYL, C_4H_5 , Ae.
2. METHYL, C_2H_3 , Me.
3. AMYL, $C_{10}H_{11}$, Ayl.
4. *Kakodyl*, C_4H_6AS , Kd.
5. BENZYL, $C_{14}H_5O_2$, Bz.
6. *Salicyl*, $C_{13}H_5O_4$, Sl.
7. *Cinnamyl*, $C_{13}H_7O_2$, Ci.

Of these, the first three present strong analogies in their chemical relations.

ETHYL, C_4H_5 , or Ae, is the radical of *Æther* (C_4H_5)O, or AeO, which is obtained from Alcohol, the latter being a Hydrate of *Æther*, or a Hydrated Oxide of Ethyl (C_4H_5)O,HO or AeO,HO. It has been isolated, and its compounds are termed *Æthers*.

METHYL, C_2H_3 , or Me, is in like manner the radical of the *Wood Æther*, obtained from *Wood Spirit*, a product of the destructive distillation of Wood, and which is a Hydrated Oxide of Methyl (C_2H_3)O,HO.

AMYL, $C_{10}H_{11}$, is the radical of *Amyl-Ether* ($C_{10}H_{11}$)O, obtained from *Fusel Oil* or *Potato Oil* ($C_{10}H_{11}$)O,HO, which may be called the Alcohol of Amyl.

Alcohol, when oxidized, gives *Acetic Acid* (*Vinegar*), $C_4H_3O_3$ HO; *Wood Spirit* gives *Formic Acid*, $C_2H_3O_3$, and *Fusel Oil* gives *Valerianic Acid*, $C_{10}H_9O_3$,HO.

We see then, that *Æther* (*Sulphuric Æther*) is the Oxide of *Ethyl*; *Alcohol*, the Hydrate of *Æther*; and *Acetic Acid*, Oxidized *Alcohol*. *Wood Æther* is the Oxide of *Methyl*; *Wood Spirit*, the Hydrate of *Wood Æther*; and *Formic Acid*, Oxidized *Wood Spirit*. *Amyl Ether* is the Oxide of *Amyl*; *Fusel Oil*, the Hydrate of *Amyl Æther*; and *Valerianic Acid*, Oxidized *Fusel Oil*.

a. **ETHYL**, C_4H_5 .

a. **Ethyl**, C_4H_5 , or Ae.

- b. *ÆTHER, C_4H_5O , AeO.
- c. Nitrous Æther, C_4H_5O, NO_3 , AeO, NO₃.
- d. *ALCOHOL, C_4H_5O, HO , Ae, O, HO.
- e. *Aldehyde*, C_4H_3O, HO .
- f. *ACETIC ACID, $C_4H_3O_3, HO$.

Beside these there are many others not used in medicine, as Hydrochloric Æther, AeCl; Nitric Æther, (proper), AeO, NO₅; Sulphuric Æther (proper), AeO, SO₃; Carbonic Æther, AeO, CO₂, &c., &c., which serve to illustrate the series.

a. Ethyl has been isolated as a colourless gas, condensing at -9° . As yet none of the series have been formed directly from it.

*b. OXIDE OF ETHYL—*ÆTHER, AeO.*

Prop. Is formed by the action of Sulphuric Acid upon Alcohol, aided by heat; is often, but erroneously called Sulphuric Æther. Equal weights are introduced into a retort, connected with a good condensing apparatus, and the distillation carried on, until the materials in the retort begin to froth and blacken, owing to the charring and destruction of the Alcohol. The Æther is purified by agitation with a solution of Potassa and redistillation at a gentle heat.

Prop. Pure Æther is a colourless, very volatile, limpid liquid, of an agreeable smell, and pungent taste. The officinal Sp. Gr. is 0.750; when perfectly pure is

0·713 : the latter boils at 95° ; Sp. Gr. of vapour, 2·586. Æther has never been frozen. It burns readily, producing Carbonic Acid and Water; mixed with Air or Oxygen, it explodes violently ; it is soluble in 10 or $\frac{1}{10}$ parts water. It dissolves most of the Fats and Oils, also Iodine, Bromine, Phosphorus, Corrosive Sublimate. Æther contains Alcohol, from which it is freed by agitation with Water, which with the Alcohol subsides ; the Æther is then decanted, and freed from the small quantity of water dissolved by redistilling with Lime. When kept in a loosely-stopped bottle, it rapidly evaporates ; that which remains may become acid from the absorption of Oxygen, and consequent formation of Acetic Acid.

Rem. In the formation of Æther, the Sulphuric Acid evidently acts by separating the Water and Ether, which combined form the Alcohol. It does not, however, combine with the Water, as by the *continuous process* for the manufacture of Æther, in which a stream of Alcohol is made to flow through the Acid, kept at a certain temperature, the same quantity of Acid may be made to convert an indefinite quantity of Alcohol into Æther, the separated Water being distilled over with the Æther. Other substances, as Caustic Potassa, having a strong affinity for Water, do not convert Alcohol into Æther. Alcohol may be made by the direct combination of Æther and Water.

Med. Effects. Anæsthetic, diffusible stimulant, anti-

spasmodic ; externally as a refrigerant, the cold produced by its rapid evaporation being considerable.

1. *SPIRITUS ÆTHERIS COMPOSITUS—Compound Spirit of Æther—Hoffman's Anodyne.

Prep. Is made by mixing *Ætheris Oss, Alcohol. Oj, Ol. Ætherei fʒij.* The *OLEUM ÆTHEREUM, Ethereal Oil, heavy Oil of Wine, which is characteristic of this preparation, is made by distilling Alcohol with an excess of Sulphuric Acid. It is a yellowish liquid, of an oleaginous consistency, penetrating, aromatic odour, and rather sharp and bitter taste. It consists essentially of a double Sulphate of Æther and Ætherine, an hypothetic radical, C_4H_4 . $(C_4H_5O)SO_3 + (C_4H_4)SO_3$. Very little true Oil of Wine is to be found in the shops.

Prop. Hoffman's Anodyne is a liquid, possessing most of the properties of Æther, and an odour of Æthereal Oil ; it frequently does not contain the latter. It should become milky on the addition of water, owing to the precipitation of the oil ; this oil, when collected on bibulous paper, should completely volatilize by heat ; any fixed oil is an adulteration. It is employed as an anodyne, and antispasmodic. Dose, fʒj to fʒss.

**c. NITRATE OF OXIDE OF ETHYL—Nitrous Æther,
 $C_4H_5O.NO_3$ or $AeO.NO_3$.**

Prep. By the direct action of Nitrous Acid on Alcohol.

Prop. A pale, yellow, very volatile liquid, of an agreeable smell ; boils at 62° ; Sp. Gr. 0.947.

1. *SPIRITUS ÆTHERIS NITRICI—*Spirit of Nitric (Nitrous) Ether*—Sweet Spirits of Nitre.

Prep. Is made by the action of Nitric Acid,—evolved by the action of Sulphuric Acid on Nitrate of Potassa—on Alcohol, and redistilling from Carbonate of Potassa. It consists of Nitrous Æther, AcO_2NO_3 , dissolved in Alcohol.

Prop. A colourless volatile liquid, of a fragrant, ethereal odour; boils at 160° ; Sp. Gr. 0·834. Becomes acid when kept in badly-stoppered bottles, Acetic Acid being formed. It may also contain *Aldehyde*; this gives a brown colour, when mixed with solution of Potassa. The presence of any acid in excess is shown by its action on litmus, and by the usual tests. It is often adulterated by mere dilution with alcohol and water.

Med. Effects. Diuretic, diaphoretic, antispasmodic. Dose, gtt. xxx to f 3ij.

d. HYDRATED OXIDE OF ETHYL—*ALCOHOL, $\text{C}_2\text{H}_5\text{O}$, HO or AcO_2HO .

Prep. May be formed by the direct combination of Æther and Water; is obtained by the vinous *fermentation*. As generally prepared by distillation, it contains a notable proportion of water, from which it may be freed by redistilling with Chloride of Calcium, giving *Absolute Alcohol*; this has a Sp. Gr. of 0·7938; the officinal ALCOHOL has a Sp. Gr. of 0·835; Proof Spirit, 0·920.

Prop. A colourless, transparent, volatile, inflammable liquid, of a penetrating, agreeable odour, and burning

taste ; boils at about 176° ; dissolves Sulphur and Phosphorus in small quantity, Iodine and Ammonia freely, Caustic Potassa, Soda, and Lithia ; the Organic Alkalies, Tannic Acid, Grape Sugar, Camphor, Resins, Balsams, Volatile Oils, Soap, the Fixed Oils sparingly, except Castor Oil, which is abundantly soluble ; most Acids and their Salts give with it, on distillation, their characteristic Æthers ; all deliquescent Salts, except Carbonate of Potassa, most of the soluble Chlorides, and some Nitrates are soluble in alcohol ; all efflorescent Salts, those insoluble, or sparingly soluble in water, and the Metallic Sulphates, are insoluble. Solutions in Alcohol are called *Tinctures*, or Spirits.

Med. Effects. In overdose, narcotic poison ; in moderate quantities, stimulant ; seldom used alone externally. Besides the Tinctures, Liniments, &c., into which it enters, Wine and Brandy are officinal, as *VINUM ALBUM, *Sherry Wine* ; this is the Wine used in making the *Medicated Wines*, *Vina Medicata* ; *VINUM RUBRUM, Port Wine, and *SPIRITUS VINI GALLICI, Brandy.

e. Aldehyde, C_4H_3O, HO .

Prep. Produced by the oxidation of Alcohol ; is intermediate between it and Acetic Acid.

Prop. Is a limpid liquid, of a characteristic æthereal odour, which, when strong, is suffocating. Sp. Gr. 0.790. On exposure to air, speedily oxidized to Acetic Acid. May be considered as the Hydrated Oxide, or Alcohol of a radi-

cal Acetyl (C_4H_3), of which Acetic Acid is the highest acid.

f. ACETIC ACID—Vinegar, $C_4H_3O_3$, HO.

Prep. Is formed by the complete oxidation of Alcohol. Alcohol does not oxidize spontaneously, when exposed to the air, but will do so, when a ferment is present, or when passed through the pores of Platinum Black, Beech Shavings, &c. Acetic Acid is also obtained by the destructive distillation of wood. This Acid, which has a peculiar smoky odour when crude, is known as *Pyroligneous Acid*.

Acetic Acid is officinal: 1. As *ACETUM, Vinegar, "impure dilute Acetic Acid, prepared by fermentation," and 2. *ACIDUM ACETICUM, Acetic Acid, "Acetic Acid, of the Sp. Gr. 1·041," purified Pyroligneous Acid.

1. *ACETUM—Vinegar.

Prep. Is prepared in various modes, from Wine, Cider, Beer, &c.; the principle being the same in each, the oxidation of the alcohol in the liquor.

Prop. Vary with the variety; has generally an agreeable smell; pleasant, acid taste; its colour varies from pale yellow to deep red. It contains, besides Acetic Acid and water, Gum, Sugar, Gluten, some Sulphates, and often, Tartaric and Malic Acids. The most common impurities are Sulphuric Acid, detected by boiling with Chloride of Calcium (Barium being inadmissible), Muriatic Acid, Copper, and Lead, which may be detected by the usual tests.

Uses. It is used as a refrigerant, and for its agreeable odour.

2. *ACIDUM ACETICUM—Acetic Acid. Sp. Gr. 1·041.

Prep. Is obtained from the *Pyroligneous Acid*, a product of the destructive distillation of Wood. The crude Acid contains Tar, Wood, Alcohol, and Empyreumatic Oils. It is purified by combination with Lime, afterwards with Soda, and the decomposition of the latter by Sulphuric Acid. When Acetate of LEAD is dried and decomposed by Sulphuric Acid, an Acetic Acid is obtained, containing but one eq. of water (Glacial Acetic Acid). This is a clear, corrosive, volatile, inflammable liquid, which blisters the skin. At 40° it becomes a crystalline solid. The anhydrous acid has been isolated.

Prop. Officinal Acetic Acid is a colourless, volatile liquid, uniting in all proportions with Alcohol and Water. It may contain Mineral Acids, or Copper, or Lead as impurities.

Med. Uses. It forms with bases the ACETATES, most of which have been already considered. It is used also in preparing the officinal VINEGARS: ACETA MEDICATA.

- b. METHYL, C_2H_3 .
- a. Methyl, Me, C_2H_3 .
- b. Oxide of Methyl, MeO, C_2H_3O , Methyl Æther.
- c. Hydrated Oxide of Methyl, MeO, HO, C_2H_3O, HO , Wood Spirit.
- d. Formic Acid, $C_2H_3O_3, HO$.
- e. *CHLOROFORM, C_2HCl_3 .

a. Methyl has not been satisfactorily isolated.

b. *Oxide of Methyl*, C_2H_3O or MeO —Methyl Äther.

Prep. Produced by the action of Sulphuric Acid upon Wood Spirit, in a manner analogous to that for forming Äther. A large number of Methyl compounds corresponding to the Ethyl series, may be formed by the action of Acids, Salts, &c., upon Wood Spirit.

c. *Hydrated Oxide of Methyl*, C_2H_3O, HO , or MeO, HO —Wood Spirit—Pyroxilic Spirit—Wood Naphtha, is the Alcohol of the Methyl series.

Prep. Obtained during the destructive distillation of Wood. Is officinal in the Dub. Ph. as *Spiritus Pyroxilicus*.

Prop. A colourless, thin, mobile, inflammable liquid, with a peculiar smell, and burning taste; boils at 152° ; Sp. Gr. 0.798; mixes in all proportions in the water; its solvent powers resemble those of Alcohol.

Med. Effects. It has been much used under the name of *Acetone* or Wood Naphtha, in phthisis. Also used as a sedative, and to check obstinate vomiting.

Dose, gtt. x to xl.

d. *Formic Acid*, C_2HO_3, HO or MeO_3HO .

Prep. By the oxidation of Wood Spirit; exists abundantly in the bodies of Ants, whence its name. Is a frequent result of the oxidation of organic bodies.

Prop. Hydrate of Formic Acid, resembles Glacial Acetic Acid, and is obtained, by an analogous process,

from the Formate of Lead. It is very corrosive. None of its salts are used in medicine.

e. CHLOROFORM, C_2HCl_3 .

Prep. By the substitution of Chlorine, Iodine, or Bromine, for the Oxygen of dry Formic Acid, Chloroform, Iodoform, C_2HI_3 , and Bromoform, C_2HBr_3 , are obtained. The first of these is officinal as

*CHLOROFORMUM—Chloroform.

Prep. By distilling Alcohol with Chlorinated Lime.

Prop. A thin, colourless, volatile liquid, of an agreeable, æthereal smell, and sweetish, burning taste; Sp. Gr. 1·49; boils at 142° ; does not burn; insoluble in water; soluble in Alcohol and Æther. Dissolves the Volatile Oils, Resins, Camphor, &c. Should be neutral to Test Paper, and not bleach it; should sink in a mixture of equal weights of Oil of Vitriol and Water, which has a Sp. Gr. of 1·38; should not be coloured by pure and strong Oil of Vitriol. *Chloric Æther*, so-called, is a solution of Chloroform in Alcohol.

Med. Effects. 1. Anæsthetic; 2. Sedative narcotic. Externally rubefacient and locally anæsthetic.

Dose, gtt. v to xl.

c. AMYL, $C_{10}H_{11}$.

a. Amyl, $C_{10}H_{11}$, Ayl.

b. Oxide of Amyl—Amyl Æther, $C_{10}H_{11}O$.

c. *Hydrated Oxide of Amyl* (Fusel Oil), $C_{10}H_{11}O_2HO$.

d. *Valerianic Acid*, $C_{10}H_9O_3HO$.

The compounds of Amyl, forming a series analogous to the Ethyl and Methyl, may be made by acting on *Fusel Oil*, a substance obtained from Potato or Corn Spirit.

c. *Hydrated Oxide of Amyl*—Fusel Oil.

Prop. When pure, a thin fluid oil, of a powerful, suffocating, and burning taste; boils about 268° ; Sp. Gr. 0.818; inflames with difficulty, burning with a pure blue flame. It is officinal in the Dub. Ph. as *Alcohol Amylicum*—Amylic Alcohol, and is used as a source of *Valerianic Acid*.

d. *VALERIANIC ACID*—Valeric Acid. Bears the same relation to Amyl, as Acetic Acid does to Ethyl, and Formic Acid to Methyl.

Prop. By the oxidation of Fusel Oil; conveniently by the use of Bichromate of Potassa, which is the officinal process of the Dub. Ph. It exists naturally in the Valerian root.

Prop. The Hydrated Acid is a thin, fluid, colourless oil, having in a remarkable degree the smell of the Valerian root. Taste, sharp and acid; reddens litmus; bleaches the tongue; is inflammable; boils at 370° ; Sp. Gr. 0.937. The Valerianate of Zinc is officinal in the Dub. Ph., and is made by double decomposition of Valerianate of Soda and Sulphate of Zinc. The Valerianate of Quinia is also officinal in the Dub. Ph., and is formed by double decomposition of Muriate of Quinia and Vale-

rianate of Soda. The Valerianates have the antispasmodic effects of the Valerian.

D. KAKODYL, Kd, C_4H_6As .

Forms a large series of compounds, mostly of a highly offensive and poisonous character. The radical itself has been isolated as a thin, colourless liquid, and from it all the compounds may be directly formed, giving us the most perfect example of a quasi metal known.

Oxide of Kakodyl, C_4H_6As, O , or KdO , Alkarsin, Fuming Liquor of Cadet.

Prep. By distilling equal weights of Acetate of Potassa and Arsenious Acid. May be formed by the direct union of Kakodyl with Oxygen.

Prop. A colourless, ethereal liquid, of a highly offensive smell, irritating the nose and eyes, and very poisonous. Boils about 302° ; Sp. Gr. 1.462. Takes fire spontaneously in the air, burning with a pale flame, producing Carbonic Acid, Water, and Arsenious Acid.

From the Oxide, the other members of the series may be formed. The Chloride and Cyanide are especially poisonous, the latter perhaps the most active poison known. Kakodylic Acid, KdO_3 , formed by the oxidation of Kd , or KdO , is a solid, which is not very poisonous.

E. Benzyl.

Benzyl, $Bz, C_{14}H_5O_2$.

HYDRIDE OF $Bz, C_{14}H_5O_2H$, *BITTER ALMOND OIL.

HYDRATED OXIDE OF Bz, $C_{14}H_3O_2O, HO$, *BENZOIC ACID.

Benzyl has been isolated ; it is a crystalline substance, having the smell of the geranium.

a. *HYDRIDE OF BENZYL, BzH, Bitter Almond Oil. Officinal as *OLEUM AMYGDALÆ AMARÆ, "the oil obtained by distilling the kernels of the fruit of Amygdalus Communis." The oil does not pre-exist in the kernels, but is the result of the decomposition of a peculiar principle, *Amygdalin*, $C_{40}H_{27}NO_{22}$, aided by a pulpy, albuminous substance, *Synaptase*. The crude oil (which is the officinal), contains a large proportion of Hydrocyanic Acid, formed during the reaction, and is used in medicine for obtaining the effects of that acid. When freed from Hydrocyanic Acid, it is used as a flavouring material, and in perfumery. Bitter Almond Oil is also formed during the decomposition of nitrogenized substances. By acting upon Benzole, a liquid obtained by the distillation of Benzoic Acid with Caustic Lime, and also of Coal Tar, with fuming Nitric Acid, a substance, *Nitro-Benzole*, is obtained, and by the distillation of Hippuric Acid, *Nitro-Benzyl*; both of these substances have the odour of the Bitter Almond Oil in a remarkable degree, and are substituted for it in perfumery.

Prop. The officinal (crude) oil has a yellowish colour, bitter, acrid, burning taste, and a characteristic smell ; Sp. Gr. 1·052 to 1·082. The pure oil is colourless ; Sp.

Gr. 1·043 ; boils at 356° ; soluble in 30 parts water, and in all proportions in Alcohol and Æther. The pure oil is not poisonous. The officinal oil is sometimes used as a substitute for the officinal Hydrocyanic Acid, but being variable in strength, should not be employed.

b. HYDRATED OXIDE OF BENZYL, BzO_2HO , *BENZOIC ACID, *ACIDUM BENZOICUM.

Prep. Officinally, by subliming *BENZOIN. Also, by boiling the gum with Lime, and precipitating the Benzoic Acid, by adding HCl, and in large quantity from the putrid urine of herbivorous animals, being formed by the decomposition of Hippuric Acid.

Prop. Light, feathery, colourless crystals, having a faint smell when rubbed, or warmed ; melts a little below 212° ; soluble in 200 parts cold, 25 boiling water ; soluble in solutions of Borax, or Phosphate of Soda. Forms Benzoates, all of which are soluble ; none are used in medicine.

Med. Effects. Mildly astringent to the urinary organs, resembling, in its effects, Buchu or Uva Ursi. Dr. Wm. M. Uhler has proposed and used it as a remedy in diabetes. Given in enuresis. Dose, gr. x to xxx. Taken internally, it passes off in the urine as HIPPURIC ACID. (See URINE.)

The other members of the Benzyl series are not used in medicine.

f. Cinnamyl, $C_{18}H_7O_2Cl$.

Is the radical of a series, of which the Hydride, $C_{18}H_7O_2ClH$, *OIL OF CINNAMON, *OLEUM CINNAMOMI, is the only member employed in medicine. It is used as a stimulant. Oil of Cinnamon may be artificially prepared by the oxidation of *Styrone*, which is obtained by the distillation of *STORAX with Caustic Potassa.

g. Salicyl, $C_{14}H_8O_4$.

Is the radical of a series, of which the Hydride is identical with the Oil of *Spiraea ulmaria*, or Meadow-sweet. It is obtained from *Salicin* ($C_{26}H_{18}O_{14}$), a crystalline, bitter principle, derived from the bark of the willow, poplar, &c. Salicin may be artificially made by the action of Caustic Potassa upon the Oil of *Gaultheria procumbens*, *OLEUM GAULTHERIAE. Salicin is employed as a substitute for Quinia. *Phloridzin*, $C_{42}H_{24}O_{20} + 4HO$, is an analogous substance, found in the bark of the root of the cherry, apple, &c.

2. Organic Salt Radicals.

h. Cyanogen, NC_2 or Cy.

Resembles the Halogens; has been considered page 50.

a. FERROCYANOGEND, N_3C_6Fe , or FCy. Exists only in combination.

Prep. May be prepared in combination with Potassium, by digesting CYANIDE OF POTASSIUM with Iron

Filings; Oxygen is absorbed. $3\text{K}(\text{NC}_2) + \text{Fe} + \text{O} = \text{KO} + \text{K}_2\text{N}_3\text{C}_6\text{Fe}$, or KFCy. See *POTASSII FERROCYANURETUM, p. 89; and *FERRI FERROCYANURETUM, p. 133.

b. FERRICYANOGEN, $\text{C}_{12}\text{N}_6\text{Fe}_2$, or FdCy. Has not been isolated.

Prep. Its compound with Potassium is formed when Chlorine is passed into a solution of Ferrocyanide of Potassium. The Chlorine abstracts an eq. of Potassium from two of KFCy, giving K_3FdCy .

Prop. Ruby red, transparent crystals; permanent in the air; soluble in 4 parts cold water. Sometimes called Red Prussiate of Potash. Gives a blue precipitate with Salts of the Protoxide of Iron—Turnbull's Blue, Fe_3FdCy .

Sulphocyanogen, C_2NS_2 or CSy. Is obtained in combination with Potassium in anhydrous, colourless, deliquescent plates; soluble in water and alcohol. A soluble Sulphocyanide strikes a blood-red colour, with Salts of Sesquioxide of Iron, but gives no precipitate. It is on this fact that Liebig's test for Hydrocyanic Acid is formed. Exists in combination in the saliva of man.

III. ORGANIC ACIDS.

Organic Acids not Oxides of known radicals, or not otherwise classified. The most important are :—

*TARTARIC Acid,	$C_4H_4O_{10}, 2HO.$
*CITRIC " "	$C_{12}H_5O_{11}, 3HO.$
Malic " "	$C_8H_4O_8, 2HO.$
*TANNIC " "	$C_{18}H_5O_9, 3HO (?) C_{40}H_{18}O_{26} + 8HO.$ (Strecker.)
*GALLIC " "	$C_7H_6O_3, 2HO.$

A. *TARTARIC ACID—*ACIDUM TARTARICUM.

The acid of grapes, tamarinds, &c., is obtained from the deposit in wine casks (Argol, Crude Tartar), which is impure Acid Tartrate (Bitartrate) of POTASSA.

Prep. By decomposing the Acid Tartrate of Potassa, by Carbonate of Lime; and the resulting Tartrate of Lime, by Sulphuric Acid.

Prop. White, crystalline, solid. The crystals contain two eq. of basic water, which can only be replaced by a base; hence the acid is bibasic. It is soluble in its weight of cold, and one-half of boiling water. Forms Tartrates; of which those of Potassa, and the double salts of Potassa and Soda, of Iron and Potassa, and of Antimony and Potassa, are officinal.

Tests. Gives white precipitate with Lime, Baryta Water, and Acetate of Lead; soluble in excess. With Potassa, when the acid is in excess, a sparingly soluble white Acid Tartrate (Bitartrate).

Med. Effects. Refrigerant; in over dose, irritant poison. Used in preparing effervescing mixtures; as the Soda

Powders, and Seidlitz Powders. The former consisting of Tartaric Acid and Bicarbonate of Soda; the latter of Tartaric Acid and Bicarbonate of Soda, with Tartrate of Potassa and Soda (Rochelle Salt).

B. *CITRIC ACID—*ACIDUM CITRICUM.

The acid of lemons, limes, &c.

Prep. By saturating lemon juice with Chalk, and decomposing the Citrate of Lime thus formed by Sulphuric Acid.

Prop. Transparent crystals; permanent in the air; soluble in $\frac{3}{4}$ its weights of cold, and $\frac{1}{2}$ of boiling water. The crystals contain four eq. water; three of which are basic. It is, therefore, Tribasic. It forms Citrates; of which those of Potassa, Magnesia, and Iron, are officinal. It should give no precipitate with a Potassa salt.

Tests. The Citrates of Lime, Baryta, Strontia, Lead, and Silver, are insoluble, and white.

Med. Effects. Used in making acidulous drinks, and effervescent draughts.

c. Malic Acid.

The acids of apples, pears, &c.

Prop. It is Bibasic, and forms Malates. Is not used in medicine.

D. *TANNIC ACID—*ACIDUM TANNICUM.

E. *GALLIC ACID—*ACIDUM GALLICUM.

These acids constitute the astringent principle of vegetables. Their acid character is not very marked.

Prep. TANNIC ACID is prepared by pouring ordinary \AA ether upon powdered Galls, in a displacement apparatus. The water of the \AA ether dissolves the Tannic Acid, while the \AA ether retains the Gallic Acid and impurities. The two separate into layers; they are separated, and the Tannic Acid obtained by careful evaporation.

Prop. Tannic Acid is a slightly yellowish, friable, porous mass, without the slightest tendency to crystallization. It has a pure, astringent taste; is freely soluble in water; reddens litmus; precipitates Albumen, Gelatin, Starch, Gluten; the salts of Lead, Copper, Silver, Mercury, Teroxide of Antimony, Protoxide of Tin, Sesquioxide of Iron; Sulphuric, Nitric, Hydrochloric, Phosphoric, and Arsenic Acids insoluble in excess of acid; the Alkaloids, the precipitate being soluble in the Vegetable Acids,—hence it is not to be relied on as an antidote.

GALLIC ACID. *Prep.* May be formed by exposing Tannic Acid for a long time to the air; a fermentation takes place, Oxygen is absorbed, and an equal volume of Carbonic Acid given out. Strecker views Tannic Acid as a combination of Gallic Acid and Grape Sugar; which

latter is destroyed by fermentation, $2(C_{40}H_{18}O_{26}) + 8HO = 8(C_7H_6O_3 \cdot 2HO)$, Gallic Acid, and $C_{24}H_{28}O_{28}$, Glucose.

Prop. White, silky, feathery crystals; soluble in 100 parts cold, and 3 boiling water; solution has an acid, astringent taste, reddens litmus, and spontaneously decomposes. Does not precipitate Gelatin; produces a deep, bluish-black colour with Salts of the Sesquioxide of Iron, which disappears when the solution is heated. By heat, new acids are produced, the Pyrogallic and Metagallic.

Med. Effects. Tannic and Gallic Acids possess the properties of the vegetable astringents. The latter is seldom used.

IV. ORGANIC BASES.

Organic bases, not Oxides of known radicals, and not otherwise classified. The most important are

*MORPHIA, $C_{34}H_{25}N O_6 + 2HO$.

Narcotina, $C_{48}H_{25}N O_{14}$.

QUINIA, $C_{20}H_{12}N O_2$.

QUINIDIA, $C_{18}H_{11}N O$.

Cinchonia, $C_{20}H_{12}N O$.

*STRYCHNIA, $C_{42}H_{22}N_2O_4$.

Brucia, $C_{46}H_{26}N_2O_8$.

*VERATRIA, $C_{34}H_{22}N O_6$.

ACONITINA, $C_{60}H_{47}N O_{14}$.

Conia, C₁₆H₁₅N.

Nicotina, C₁₀H₇N.

ATROPIA, C₃₄H₂₃N O₆.

Hyoscyamine, C₃₄H₂₃N O₆.

Emetia, C₃₅H₂₁N O₉?

Caffein, C₁₆H₁₀N₂O₄.

Piperine, C₃₁H₁₉NO₆.

These are known as the Alkaloids. They contain Nitrogen; they form, with acids, salts, some of which are well-characterized; they are generally insoluble in Water; soluble in Alcohol; their salts are generally soluble in Water; they all possess the medical properties of the substances from which they are extracted; are as a class highly poisonous. Tannic Acid precipitates them, but as the compound is soluble in the gastric juice, is hardly to be relied on as an antidote. Animal Charcoal removes them from solution, and when in sufficient quantity (3j of purified Animal Charcoal to gr. j of the Alkaloid) with, or immediately after them, prevents their action. The tests which have been proposed for them cannot be considered as sufficiently characteristic to be depended upon, particularly when they are mixed with organic matters.

As the Alkaloids are always prepared by the manufacturing chemist, and as the processes for their extraction and separation are intricate, they will not be here detailed.

Alkaloids of *OPIUM.

The following have been isolated : they exist combined with a peculiar acid, the *Meconic*, $C_{14}H_{11}O_13HO + 6HO$, and with Sulphuric Acid; ***MORPHIA**, *Narcotina*, *Codeia*, *Paramorphia*, *Narcein*, *Meconin*, *Porphyroxin*, *Pseudomorphia*, *Papaverina*, and *Opiania*. Of these, the only one officinal is

A. ***MORPHIA**.

Prop. Is in small, very brilliant, transparent, colourless crystals, soluble in 1000 parts cold, 30 of boiling Water, and freely in dilute Acids, forming its salts ; also in excess of Caustic Potassa or Soda, but hardly in Ammonia. When in powder, it gives a blood-red tinge, changing to yellow with Nitric Acid ; a deep bluish colour, with Sesquioxide of Iron ; decomposes Iodic Acid, with liberation of Iodine.

1. ***MORPHIÆ SULPHAS**—Sulphate of Morphia.

Prep. Is made by dissolving Morphia in dilute Sulphuric Acid, and evaporating to dryness.

Prop. Is in minute, dry, feathery crystals, of a bitter taste ; freely soluble in water.

Dose, gr. $\frac{1}{2}$ to $\frac{1}{4}$.

2. The ***LIQUOR MORPHIÆ SULPHATIS**—Solution of Sulphate of Morphia, contains gr. j to f $\frac{2}{3}$ j *Aq.*

Dose, f $\frac{2}{3}$ j to f $\frac{2}{3}$ ij.

3. ***MORPHIÆ MURIAS**—Muriate of Morphia.

Prop. Is made by dissolving Morphia in dilute Muriatic Acid.

Prop. Resembles the Sulphate in general properties and dose.

4. *MORPHIÆ ACETAS—Acetate of Morphia.

Prop. Is made by dissolving Morphia in Acetic Acid. Crystallizes in fine needles, united in fasciculi, soluble in Water; sometimes contains a little uncombined Morphia, which may be dissolved by the addition of a few drops of Acetic Acid.

Prop. Properties and dose, those of the Sulphate.

None of the other Alkaloids of Opium are employed in medicine.

Alkaloids of *CINCHONA.

Are associated in the bark with Sulphuric and *Kinic* Acids. They are *Quinia*, *Cinchonia*, and *Quinidia*. The Yellow Bark (Calisaya Bark) contains a large quantity of Quinia with little Cinchonia; the Pale Bark (Loxa Bark) contains much Cinchonia with little Quinia; and the Red Bark contains both Alkaloids.

B. QUINIA.

Prop. May be obtained in silky crystals, soluble in 400 parts cold and 250 boiling Water; soluble in Alcohol, Æther, and the Fixed and Volatile Oils. It is not official, but its Sulphate is.

Tests. Its salts give an emerald-green colour, when treated with Chlorine Water and afterwards with Ammonia; this changes to a white or violet upon the addition of a dilute Acid.

1. **QUINIAE SULPHAS*—Sulphate of Quinia.

Prop. It is in fine silky, slightly flexible, needle-shaped crystals, of an intensely bitter taste; soluble with difficulty in cold water, but rendered readily so by the addition of a small portion of Sulphuric or Tartaric Acid.

Tests. It should be entirely volatilized by heat, give no odour of Ammonia upon the addition of Caustic Alkali; its solution with cold, concentrated Sulphuric Acid be colourless; it should be entirely soluble in Alcohol and Æther; its solution in water should be devoid of sweet taste. These tests prove the absence of the ordinary substances used in adulterating it. *Salicin* may be detected by the red colour it gives with strong Sulphuric Acid. *Cinchonia*, by treating the suspected solution with Chlorinated Lime, Lime Water, or Ammonia; the precipitate which falls, if Quinia, is soluble in excess, but insoluble, if Cinchonia. A solution of Chloride of Calcium yields a precipitate with Sulphate of Cinchonia, and none with that of Quinia. The 2. **PILULAË QUINIAE SULPHATIS* contain one grain each. The Muriate and Valerianate of Quinia are officinal in the Dub. Ph.

c. Cinchonia.

Prop. May be obtained in white crystals, insoluble in cold Water, soluble in 2500 parts boiling Water, and in boiling Alcohol; very slightly soluble in Æther and the Volatile Oils. Its solutions are very bitter. The Sulphate has been employed as a substitute for Sulphate of Quinia; it possesses the same properties, but is less active.

d. Quinidia has been recently used with success as a substitute for Quinia (Cullen, Pepper).

*D. *STRYCHNIA.*

Nat. Sources. Exists in the **NUX VOMICA* (*Strychnos Nux Vomica*), Bean of St. Ignatius (*Strychnos Ignatii*), and from the false Augustura Bark (*Strychnos Nux Vomica*), together with Brucia.

Prop. Is a grayish-white powder; may be obtained in crystals; is soluble in 6667 parts cold and 2000 boiling water; soluble in boiling Alcohol, but very sparingly in cold or absolute Alcohol, or Æther. Its Solutions and Soluble Salts are intensely bitter.

Tests. Dissolved by Sulphuric Acid with $\frac{1}{60}$ th of Nitric and a minute quantity of Peroxide of Lead added, a blue colour is produced, rapidly passing into violet, red, and yellow. A crystal of Bichromate of Potassa added to its solution in Concentrated Sulphuric Acid, produces a violet colour. The Muriate is officinal in the Dub. Ph.

Strychnia possesses the effects of Nux Vomica in a high degree.

Antidote, Camphor?

Dose, gr. $\frac{1}{16}$ to $\frac{1}{10}$, gradually increased.

E. Brucia.

Prop. Much resembles Strychnia, but is distinguished by its ready solubility in Alcohol. It gives a bright red tinge with Nitric Acid, changed to yellow by Protochloride of Tin.

F. *Veratria.

Found in various species of *Veratrum*, *VERATRUM ALBUM, *VERATRUM VIRIDE, and *V. SABADILLA.

Prop. White, pulverulent, inodorous; insoluble in water, soluble in hot Alcohol and Æther; has an acrid taste, and the properties of the plants whence extracted, in an eminent degree. Gives an orange-red tinge with Nitric Acid, changed to yellow by Protochloride of Tin. Dose, gr. $\frac{1}{16}$ to $\frac{1}{8}$. Used externally in Neuralgia, in ointment, or dissolved in Alcohol, gr. ij to iv to 3j.

*ACONITINA, from the *ACONITUM NAPELLUS; *Conia*, from the *CONIUM MACULATUM; *Nicotina*, from the *NICOTIA TABACUM; *Atropia*, from the *ATROPA BELLA-DONNA; *Hyoscyamine*, from *HYOSCIAMUS NIGER; *Emetia*, from *CEPHAELIS IPECACUANHA, are all alkaloids, resembling those described, and possessing, like them, the

poisonous properties of the plants in which they naturally exist. But one, the *Aconitina, is officinal.

Caffein, or *Theine*, is found in tea, coffee, and the *Ilex Paraguensis*. Piperine is found in *PIPER NIGRUM.

V. FATS AND OILS.

These may be divided into 1. Fixed, 2. Volatile.

1. FIXED OILS.

General Prop. They communicate a greasy stain to paper, not removed by heat; cannot be distilled without decomposition; they all absorb Oxygen from the air, and either dry up (drying oils), or thicken, and become rancid; they have generally little smell and taste; all are insoluble in Water; but slightly so in Alcohol, except Castor Oil, which dissolves freely; Æther, and the Volatile Oils, dissolve them freely; their consistence varies from that of tallow to the fluid condition; they are generally liquid at ordinary temperatures; mixed with bases, they combine and form *soaps*. The soap formed with Potassa, is soft; with Soda, hard; and with Lime, the Earths, and Metals, insoluble. Chemically, they consist of various volatile, organic acids (fat acids), united with a base, *GLYCERIN, which is set free, when the acids unite with a stronger base, in the formation of soaps.

A. *GLYCERIN, *GLYCERINA, $C_6H_{10}O_6$.

Prep. By mixing *LEAD PLASTER with boiling water,

decanting, and passing a current of Hydrosulphuric Acid through the solution, to precipitate any dissolved Lead. On the large scale, is obtained from soap-makers' waste, or by decomposing a Lime Soap.*

Prop. A colourless, inodorous liquid, of a sweet taste; soluble in all proportions in water and alcohol; insoluble in \AA ether. Its solvent powers for salts, are between those of water and alcohol. Does not ferment, or become rancid; does not dry. Is valuable as an emollient.

The solid portions of fats consist of *Stearin*, a compound of *Stearic Acid* with Glycerin, and *Margarin*, a compound of *Margaric Acid* with Glycerin; the fluid portions, of *Olein*, Oleate of Glycerin.

STEARIC and MARGARIC Acids much resemble each other.

B. Stearic Acid is obtained in crystalline, white, inodorous, tasteless needles; melts at about 130° ; insoluble in Water, and nearly so in cold Alcohol and \AA ether.

C. Margaric Acid appears, from recent researches, not to be a distinct acid, but a mixture of Stearic Acid, and of *Palmitic Acid* ($\text{C}_{32}\text{H}_{32}\text{O}_3\text{,HO}$), obtained from Palm Oil (Heintz).

* Mr. Tilghman has recently patented a process for the decomposition of fats and oils, and precipitation of the fat acids, by the use of water under high pressure and temperature.

D. OLEIC Acid, $C_{36}H_{32}O_3HO$, is a colourless liquid, of a distinct acid reaction, and sharp taste. Among the other fat acids, which are combined with Glycerin in various oils, may be named: Ricinoleic, from *CASTOR OIL; Butyric, Capric, Caprylic, and Caproic, from Butter. A Butyrate of Glycerin has been formed by direct combination, being the first instance of the union by a fat acid with its base artificially. E. *WAX contains *Cerotic Acid* and *Myricin*, which is a compound Äther. F. *SPERMACETI contains Cetyl Alcohol, a solid substance, resembling Spermaceti itself, and Cetyl Acid, the product of the oxidation of this alcohol.*

2. Volatile Oils.

A. Containing Carbon and Hydrogen.

*OIL OF TURPENTINE, $C_{20}H_{16}$. Obtained by distilling crude Turpentine. Its properties are well known. By the action of Hydrochloric Acid Gas, is converted into artificial Camphor, $C_{20}H_{16}HCl$. The following Oils are isomeric with Oil of Turpentine: the cause of the difference of odour has not been determined: *LEMON, Orange Peel,

* According to Heintz, Spermaceti consists only of Stearic, Palmitic, Myristic ($C_{28}H_{28}O_4$, from Oil of Nutmeg), and Lauro-Stearic ($C_{24}H_{24}O_4$, from Oil of Laurel Berries), Acids, with Cetyl. He states that there can be no true fat acid, whose composition does not correspond to the formula, $C_nH_nO_4$, in which n is a number divisible by 4, without a remainder. Certain mixtures of fat acids have a lower fusing-point than their constituents, resembling fusible alloys.

Black Pepper, *CUBEBS, *JUNIPER, *SAVIN, *COPAIVA,
 *BERGAMOT, Cedar, Pine.

b. Containing Carbon, Hydrogen, and Oxygen. These form the great bulk of the Volatile Oils. Among them, the following are officinal : Oil of Roses, Spearmint, Peppermint, Horsemint, Anise, Fennel, Caraway, Lavander, Pennyroyal, Rosemary, Marjoram, Sassafras, Cinnamon, Cloves, Camphor, Cajeput, Valerian, Gaultheria.

c. Containing Sulphur.

*OIL OF MUSTARD, $C_8H_5N_2S$, is colourless : Sp. Gr 1.015 ; of a pungent smell, and vesicates rapidly. The Oil of *Horse-radish is identical. Oil of Garlic, C_6H_5S , Oil of *Assafætida*, $C_{12}H_{12}S_2$, and the Oil of Onions, belong to the same class.

d. RESINS. Are generally vegetable products, and seem to have been formed by the oxidation of Volatile Oils. Pure Resins are entirely soluble in Alcohol, Æther, and the Oils. Gum Resins partially dissolve in Alcohol ; the Gum not being affected ; with water they form a milky emulsion, the Gum dissolving, and suspending the Resin.

VI. COLOURING MATTERS.

A. Indigo— $C_{16}H_5NO_2$.

Nat. Sources. Obtained from several species of *Indigofera*.

Prop. Is in compact blue masses, having a coppery tinge when viewed obliquely. Cautiously heated, may be volatilized, giving a blue vapour, which condenses in delicate blue crystals. Is insoluble in water; soluble in strong Sulphuric Acid, forming *Sulphoindigotic*, and Sulphopurpuric Acids. By deoxidizing agents, is rendered colourless, but becomes blue again by exposure to the air. By the action of Nitric Acid, *Carbazotic Acid* is obtained; this forms a yellow, very slightly soluble salt with Potassa, for which it is used as a test.

Med. Effects. Antispasmodic, but little used. *Carbazotic Acid* has been successfully used as a substitute for Quinia (Bell). It may be made by acting upon *Carbolic Acid* (Coal Tar, Creasote), by Nitric Acid.

B. *Litmus.*

Obtained from *Roccella Tinctoria*, a lichen. Is used as a test for acids and alkalies. The former redden the blue infusion; the latter restore its colour when reddened. It is officinal in the Ed. Ph., as *Lacmus*.

C. *MADDER—RUBIA.

The Root of *Rubia Tinctorum*. Largely used as a red dye; with Alum, forms *Lake*. Used in medicine as an emmenagogue.

D. *LOGWOOD—HÆMATOXYLON.

The wood of *Hæmatoxylon Campechianum*. Also used

as a red purple dye. Used in medicine, as a mild astringent. Brazil-wood, obtained from several species of Cæsalpina, resembles Logwood; but has no medicinal powers.

*TURMERIC—CURCUMA. The rhizoma of Curcuma longa. Gives a yellow infusion; turned brown by alkalies—hence used as a test. Is a stimulant aromatic.

E. *COCHINEAL—Coccus.

Coccus Cacti, an hemipterous insect; used largely as a brilliant dye. With Salts of Tin, gives Carmine. Is used as an antispasmodic.

F. CHLOROPHYLLE.

The green colouring matter of leaves and grass. Is a mixture of Wax, and a green, fixed Oil.

VII. ALBUMEN GROUP.

A. ALBUMEN.

Exists in white of egg, serum of blood, and in vegetables.

Prop. Is colourless, inodorous, tasteless, insoluble; freely soluble in alkaline solutions. Its solution slowly dries into a transparent, horny mass. Natural Albumen, which may be regarded as pure Albumen rendered soluble by alkaline substances, is *coagulated*, 1. By heat, the temperature required ranging with the amount of

Albumen present. 2. By Nitric, Nitromuriatic, and *Monobasic Phosphoric Acid*. 3. By most of the metallic salts ; hence its value as an antidote. 4. By astringent infusions, Tannic Acid, and Creasote. 5. By Alcohol. The only chemical change that can be detected, after coagulation by heat, is the loss of Alkali and soluble salts. When coagulated by acids, it combines as a base ; when by the metallic salts, combines with the Oxide of the metal, acting as an Acid. Heat is not to be alone relied on, in testing for Albumen ; as the presence of Alkali in quantity, of the Mineral Acids, and of Acetic Acid, prevent its action. No certain formula can be given for Albumen.

B. FIBRIN.

Found in the clot of blood, muscular tissue, &c.

Prop. White, tasteless, inodorous ; spontaneously coagulable ; and insoluble, except in alkaline liquids. Its solution dries up into a horny mass. Acids convert it into a gelatinous mass, soluble in water. Resembles Albumen in many of its properties.

a. *Gluten.* Obtained from Wheat flour. Is chemically identical with Fibrin.

c. Casein.

Obtained from the curd of milk. When pure, much resembles Albumen, and Fibrin.

Prop. A white, curdy, tasteless, inodorous, insoluble

substance. Soluble in alkaline solutions, and, to a certain extent, in dilute acids. Solution of Casein does not coagulate on boiling. Is distinguished from Albumen, by affording a precipitate with Acetic Acid. Certain animal secretions (Rennet), coagulate it. *Legumin*, obtained from peas, beans, &c., is vegetable Casein.

The analyses of Albumen, Fibrin, and Casein, give:—

	Albumen.	Fibrin.	Casein.
Carbon,	53·5	52·7	53·83
Hydrogen,	7·0	6·9	7·15
Nitrogen,	15·5	15·4	15·65
Oxygen,	22·0	23·5	23·37
Sulphur,	1·6	1·2	
Phosphorus,	0·4	0·3	

As these substances cannot be obtained crystallized, these formulæ are only approximative.

D. Protein.

Mulder observed, that when any one of the foregoing compounds was digested in Caustic Potassa, until no precipitate was afforded with a lead salt, and precipitated by Acetic Acid, a snow-white, flocculent substance was obtained, which, he stated, could be procured entirely free from Sulphur and Phosphorus. This substance, combined with Sulphur and Phosphorus, he stated, gave Albumen, Fibrin, and Casein. The formula, $C_{24}H_{17}N_3O_8$, has been assigned it. "This is equal to a combination of

Cellulose with Ammonia, $C_{24}H_{20}O_{20} + 3NH_3 = 12HO + C_{24}H_{17}N_3O_8$. The muscular fibre is insoluble Protein, in an organized condition, and sustains a similar rank in the animal structure to that of Cellulose in the vegetable; while Albumen and Casein are insoluble, unorganized forms of Protein, and may be compared to Dextrine and Gum." (Hunt.) By the action of various reagents on Protein, two crystalline bodies, *Leucine*, $C_{12}H_{13}NO_4$, and *Tyrosine*, $C_{18}H_{11}NO_6$, are obtained. Chemists are not agreed upon these views; and for their discussion, the student is referred to works on Organic Chemistry.

E. Neurine.

Is the substance proper to the tubes and corpuscles of the nervous apparatus. Closely resembling Albumen, in composition and properties, it is considered by Robin and Verdeil, to be sufficiently distinguished by its semi-fluid consistence. Its analysis is not complete.

F. GELATIN.

Nat. Sources. Exists in animal membranes, tendons, &c.

Forms Glue. Is officinal as **ICHTHYOCOLLA*—*Isinglass*.

Prep. Is obtained by boiling. One per cent. will cause its solution to form a jelly, on cooling.

Prop. When pure and dry, is a transparent, colourless, tasteless, inodorous substance, insoluble in Alcohol and

Æther; is precipitated by Alcohol, the Chlorides, and Nitrate of Mercury, and Tannic and Gallic Acids. The process of tanning depends upon the formation of an insoluble compound of the Gelatin in the hides, with Tannic and Gallic Acids of the bark used. Its solution is not affected by Alum, or the Acetate of Lead. By boiling with strong alkalies, is converted, with evolution of Ammonia, into Leucine, and a sweet substance, *a. Glycocol*, or Sugar of Gelatin, $C_4H_5N\ O_4$, which yields, with Nitrous Acid, Glycocolic Acid, $C_4H_4O_6$. The formula, $C_{52}H_{40}N_8O_{20}$, has been given for Gelatin. *b. Chondrin* is a Gelatin, obtained from cartilages; it differs from Gelatin, in affording precipitates with Alum and Acetate of Lead; its formula has been stated as $C_{48}H_{40}N_6O_{20}$.

g. Kreatin.

Prep. Exists in soups, and may be extracted from the juice of flesh.

Prop. Has been obtained in colourless, brilliant crystals, which are soluble in boiling water, less so in cold; it is a neutral body. Crystallized, its formula is $C_8H_9N_3O_4$, $2HO$. By the action of Acids, loses the elements of water, and is converted into *a. Kreatinine*, $C_8H_7N_3O_2$, a powerful organic base, forming well-defined salts. A peculiar Bibasic Acid, *b. Inosinic*, $C_{20}H_{14}N_4O_{22}$. A peculiar Sugar, *c. Inosite*, which does not ferment; formula, $C_{12}H_{12}O_{12}+4HO$, for the crystals.

H. Other proximate principles.

Besides the above, Robin and Verdeil, and others, describe as proximate, organic principles, found in the tissues or fluids of animal bodies, or produced from them by chemical changes, the following substances, as yet incompletely known :—

Albuminose, Pancreatin, Mucosin, Crystallin, Musculin, Elasticin, Ostein, Keratin, Bilverdin, Melanin, Mosacin, Synovin, Spermatin.

I. Blood.

Prop. When freshly drawn, is a homogeneous, slightly viscid, alkaline liquid, of a peculiar odour, and saltish taste; the colour varies from the bright red of arterial, to the dark purple of venous blood. Under the microscope, is seen to consist of a transparent, nearly colourless fluid (*liquor sanguinis*), in which float red discs, the *blood corpuscles*, and colourless globules, the *white corpuscles*. It soon coagulates after being drawn, forming a *clot*, which consists of fibrin and blood-globules, and a liquid *serum*, containing albumen and salts. It consists proximately of

Water,	784·
Red Corpuscles,	131·
Albumen,	70·
Salts,	6·03
Extractive, Fatty matters, &c.,	6·77
Fibrin,	2·2
	1000·00

The red corpuscles consist of *a. Globulin*, a substance which has not been satisfactorily separated, but resembling Albumen, and of *b. Hæmatin*, the red colouring matter. This is remarkable for containing a large proportion of Iron, which is not precipitated by the usual tests for that metal. Mulder's analysis gives

Carbon,	65·84
Hydrogen,	5·37
Nitrogen,	10·4
Oxygen,	11·75
Iron,	6·64
<hr/>	
	100·00

The colour of Hæmatine does not depend wholly upon its iron, as it is not lost upon the removal of that metal. The proportion of Globuline to Hæmatine, is stated as 123·5 to 7·4.

The *Extractive* matters consist principally of *Kreatine*, the fatty matters of a peculiar fat *Seroline*, *Cholesterine*, a fat found in the bile, *Cerebrine*, a fat found in the brain, with *Oleic* and *Margaric* Acids, and traces of others.

The *Salts* are Chlorides of Sodium, Potassium, Tribasic Phosphate of Soda, Carbonate and Sulphate of Soda, and Phosphates of Lime, Magnesia, and Iron. Urea, biliary colouring matter, salivary matter, Oxygen, Nitrogen, and Carbonic Acid, are also found in varying quantities.

k. Chyle and Lymph.

Differ from blood, chiefly in the absence of the red corpuscles, and in containing a less proportion of Fibrin. The Chyle, as taken from the lacteals, contains a large proportion of fatty matter.

L. BILE.

A somewhat viscid fluid, of a varying yellow or greenish colour, strongly bitter taste, and disagreeable smell; Sp. Gr. 1·026 to 1·030. Is neutral, but as it decomposes, becomes first acid, then alkaline. Bile contains, besides mucus, fat, and the salts usually found in the secretions, a peculiar crystalline fat, *a. Cholesterine*, $C_{37}H_{32}O$, not saponifiable, fusing at 275° , soluble in Alcohol and \AA ether. Biliary Calculi are composed almost wholly of Cholesterine. The principle of Bile, *b. Bilin*, remaining after the removal of Cholesterine, fats, and salts, is believed, by Mulder and Berzelius, to be a peculiar resinoid substance, yielding, on decomposition, various acids and bases, as the Tauric, Cholic, Fellinic Acids, and Picromel and Taurine. It is a slightly yellowish, brittle mass, freely soluble in Water, and absolute Alcohol. Strecker regards it as a compound of two peculiar acids, the *Glycho-choleic*, and *Tauro-choleic*, with Soda.

M. Saliva.

A transparent, watery fluid, of an alkaline reaction; Sp.

Gr. 1·006 to 1·009. Contains, besides Water, Mucus, Albumen, Fatty matter, and the usual Salts, a peculiar principle, *Ptyaline*, and *Sulphocyanogen* in combination. The presence of the latter may be an important source of fallacy in applying the Iron test for Hydrocyanic Acid. Saliva contains 12 per cent. of Chloride of Sodium; a larger proportion than any other animal fluid. The *Pancreatic Juice* resembles Saliva in composition, but does not contain Sulphocyanogen.

n. Milk.

Under the microscope, is seen to consist of a clear liquid, in which are suspended numerous globules; these consist of fat (butter), surrounded by an albuminous envelope, which may be broken by mechanical violence (churning), or dissolved by Caustic Potassa. Milk contains Water, Butter, Casein, Milk Sugar, and the usual Salts of animal secretions. It is at first alkaline, but becomes acid, owing to the formation of *Lactic Acid*.

o. Gastric Juice.

Contains free Muriatic and Lactic Acids, and Phosphate of Lime, the Chlorides of Potassium, Sodium, Calcium, and Magnesium, and a peculiar principle, *Pepsin*. *a.* Pepsin, possesses the property of digesting most alimentary substances, when kept at the temperature of the stomach, and in con-

tact with a dilute solution of Muriatic, Lactic, or Phosphoric Acids.

P. Urine.

Prop. Varies exceedingly in properties and composition, with the individual, nature of the ingesta, temperature, &c. Colour, varies from that of water to deep red ; odour, peculiar, faint and aromatic, becoming offensive and ammoniacal from decomposition ; is transparent when first voided, but may become clouded from deposition of mucus and salts when cool ; average Sp. Gr. 1.020. Reaction in health, acid, becomes alkaline by decomposition, and may be rendered so by alkalies and vegetable diet. The following analysis by Becquerel gives its average composition :—

Water,	967.
UREA,	14.230
URIC ACID,468
Colouring and Extractive	
Matter and Mucus,	10.167
Salts,	8.135
Silica,	traces.
	1000.000

a. UREA, $\text{C}_2\text{H}_4\text{O}_2\text{N}_2$.

Forms nearly one-half of the solid matter of the urine.

Prop. It contains the elements of *Cyanate of Ammonia*, $\text{NH}_4\text{O}, \text{NC}_2\text{O}$, and may be artificially made by direct combination. It is one of the few organic substances which have been formed artificially. Is in transparent, colourless, four-sided prisms, soluble in an equal weight of cold Water and in Alcohol; inodorous; of a cooling, saline taste, and is permanent in the air, and in solution, if putrescible organic matter be absent; is decomposed by heat, &c., with evolution of Ammonia; it is neutral in reaction, but combines with acids to form well-defined salts. Nitrate of Urea is isomorphous with Saltpetre. When not excreted Urea causes Coma.

Use. Has been used as a diuretic.

b. URIC ACID, $\text{C}_{10}\text{H}_4\text{N}_4\text{O}_6$.

Exists in small quantity in human urine, abundantly in combination in that of Serpents and Birds.

Prop. Is white, tasteless, inodorous, and soluble only in 2000 parts of hot Water; it is bibasic, forms sparingly soluble *urates*. A series of very interesting compounds are formed by the reaction of chemical agents upon it. Its solution in Nitric Acid is coloured a beautiful purple by Ammonia, forming *Murexide*, which has been used as a dye. The crystals of Murexide give by reflection a metallic-green lustre, like the wing-cases of beetles; by transmitted light a deep purple-red.

c. Hippuric Acid, $\text{C}_{18}\text{H}_8\text{N O}_5\text{HO}$.

Exists largely in the urine of the Herbivora, also in human urine, when Benzoic Acid has been taken.

Prop. It crystallizes in long, slender, milk-white prisms, of a bitter taste and acid reaction; soluble in 400 parts cold Water and in boiling Alcohol. Forms *Hippurates*. By boiling Hydrochloric Acid is converted into BENZOIC ACID and GLYCOCOLL (Sugar of GELATINE). When urine containing Hippuric Acid is allowed to putrefy, it is entirely converted into Benzoic Acid: much of the Benzoic Acid of commerce is thus obtained.

URINARY CALCULI.

Are formed of concentric layers of earthy deposits and mucus. Various deposits sometimes alternate in the same calculus; frequently in the centre is found a foreign body as a nucleus.

1. Uric Acid.

Are common.

Prop. Externally are smooth or warty, of a yellowish or brownish tint; before the blow-pipe burn away, leaving no ash; insoluble in water; may be dissolved by the aid of Caustic Potassa, from which a copious white, curdy precipitate of Uric Acid falls upon the addition of acid. Dissolved in Nitric Acid, gives the characteristic purple-red of Murexide upon the addition of Ammonia.

2. Urate of Ammonia.

Prop. Differs from the last in being soluble in boiling

Water; the addition of Hydrochloric Acid gives a precipitate of Uric Acid. Dissolves in a hot solution of Carbonate of Ammonia with evolution of Ammonia.

3. Fusible Calculus—Phosphate of Lime, with Phosphate of Magnesia and Ammonia.

Are also common.

Prop. These Calculi are soft and smooth, frequently of large size; blacken before the blowpipe, then become white and melt to a bead; insoluble in Caustic Alkali; soluble in dilute Acid, which solution is precipitated by Ammonia. Calculi of unmixed Phosphate of Lime and of Phosphate of Magnesia and Ammonia (Microcosmic Salt), are sometimes found. The latter is obtained when putrescent urine is evaporated.

4. Mulberry Calculus—Oxalate of Lime.

Prop. Is usually very rough and hard. Before the blowpipe the Oxalate of Lime burns to Carbonate, and finally to Quicklime. Soluble in Hydrochloric Acid by the aid of heat, and easily in Nitric Acid. Long boiled with Carbonate of Potassa, Oxalate of Potassa may be found in the liquid.

5. Cystic Oxide, $C_6H_6NS_2O_4$.

A rare form; remarkable for containing a large proportion of Sulphur.

Prop. Is of a pale colour; waxy appearance externally. Dissolves in great part without effervescence in dilute Acids and Alkalies, including Ammonia. By long boil-

ing with Caustic Alkalies, Ammonia is disengaged. It forms a saline compound with Hydrochloric Acid.

6. Xanthic Oxide, $C_5H_2N_2O_2$.

Also very rare.

Prop. Is of a pale brown colour; waxy appearance; nearly insoluble in water and dilute acids; dissolves quietly in Nitric Acid; the solution, on evaporation, gives a deep yellow residue, becoming yellowish-brown on addition of Ammonia. Calculi should be in powder, when submitted to the action of reagents.

APPENDIX.

I.

LIST OF THE MORE COMMON POISONS, WITH THEIR CHEMICAL ANTIDOTES.

[NOTE. In all cases, the poison, or its compound with the antidote, should be as speedily as possible removed from the stomach, and its general and local effects combated by general measures.]

A. STRONG ACIDS. Alkalies, Earths. (Soap, Magnesia, Chalk, &c.)

a. { OXALIC ACID, } Lime. (Chalk, plaster of
 * TARTARIC ACID. } walls, or ceilings.)

B. ACID SALTS. Those for Acids.

a. BINOXALATE OF POTASSA, Salt of Sorrel. Lime.

C. CAUSTIC ALKALIES,
CARBONATES OF THE
ALKALIES. } Weak Acids (vinegar,
lemon juice, &c.), Oil.

D. EARTHS.

- a. BARYTA Salts. The soluble Sulphates. Elixir of Vitriol.
- b. ALUM. Carbonates of Soda, and Ammonia.
- E. Salts of the Metals.
- A. Soluble LEAD Salts. The soluble Sulphates.
- a. White lead. Dilute vinegar, with a soluble Sulphate.
- B. TIN Salts. Magnesia, the Carbonates of Soda, Milk.
- C. ZINC Salts, } Carbonates of Soda, Magnesia, or
- D. IRON Salts. } Ammonia.
- E. COPPER Salts, } Albumen, Casein (milk), Glu-
- F. MERCURY Salts. } ten (flour paste).
- G. Nitrate of SILVER. Common Salt.
- H. ANTIMONY.
- a. TARTAR EMETIC. Vegetable astringents, Magnesia.
- b. CHLORIDE OF ANTIMONY. Carbonate of Soda, or Magnesia.
- I. ARSENIOUS ACID. Hydrated Sesquioxide of Iron. Magnesia? **Ferri Subcarb.*?
- a. Fowler's Solution. Acetate of the Sesquioxide of Iron.
- K. IODINE. Boiled Starch.
- L. HYDROCYANIC ACID. Ammonia; Chlorine (taken, and cautiously inhaled). Salts of the Sesquioxide of Iron, followed by the Alkaline Carbonates? COLD DOUCHE TO THE SPINE.
- M. The ALKALOIDS. Tannic Acid? Animal Charcoal?

a. Strychnia. Camphor?

n. VENOM OF SERPENTS, and INSECTS. Ammonia, locally and generally—(Cauterization; ligature between the wound and trunk; a cupping-glass over the wound). Iodine (Brainard).

o. BITES OF RABID ANIMALS, DISSECTING WOUNDS, PUSTULA MALIGNA. No direct antidote. Cauterization, and the general measures noted in the last paragraph.

II.

LIST OF THE MORE COMMON INCOMPATIBLES.

A. ACIDS, and ACIDULOUS SALTS. All Alkalies, Ammonia; most Oxides, Carbonates, Sulphides, Iodides, Bromides, Cyanides, and Binary Compounds generally, except Alloys; the more easily Oxidized Metals. The stronger acids decompose the salts of the weaker.

a. ESPECIAL ACIDS, and their Salts. Incompatible, besides the above, with the substances affixed.

a. *Sulphuric*. The Nitrates, Phosphates, Chlorates (when concentrated); the Salts of the Organic Acids, and those of the soluble Sulphates generally.

Soluble Sulphates. Salts of Baryta, Strontia, Lime, Lead, Mercury (generally), Silver.

b. Nitric Acid. The Phosphates, Chlorates, Arsenious Acid, Salts of Antimony, those of the Vegetable Acids.

c. Hydrochloric Acid. The Salts of the Organic Acids, those of the soluble Chlorides.

Chlorides. Salts of Lead, Copper, Silver.

d. Tartaric, and Citric Acids. Salts of the Earths, and of most of the Metals.

e. Hydrocyanic Acid. Calomel, Paregoric, Nitrate of Silver, Sulphate of Copper.

f. Carbonic Acid.

Carbonates of the Alkalies. All Acids, and Acidulous salts ; most Metallic Solutions.

B. METALLIC SALTS. The Alkalies ; Ammonia ; Alkaline Earths, and their Carbonates generally ; Soap.

A. ESPECIAL SALTS. Incompatible, besides the above, with the substances affixed.

a. Of Lime. Sulphuric, Oxalic, Phosphoric, Citric, and Tartaric Acids ; and their Salts generally.

b. Alum. Salts of Lead.

c. Iron. Vegetable Astringents, Tartrates, Alkaline Carbonates, Iodine, Iodides.

d. Lead. Tartaric, Sulphuric, Hydrochloric, Phosphoric, Chromic, and Citric Acids and their Salts generally ; Iodides, Vegetable Astringents, and Infusions.

e. Copper. Nitrate of Silver, Phosphates, Chlorides of the Alkalies, Vegetable Astringents.

- f. Culomel.* Hydrocyanic Acid, Sulphides, Iodides.
g. Corrosive Sublimate. Iodides, Sulphides, Tartar Emetic, Acetate of Lead, Vegetable Astringents, Albumen, &c.
h. Nitrate of Silver. Soluble Chlorides, Iodides, Sulphates, Vegetable Astringents.
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III.

GLOSSARY.

[The figures in parentheses (), refer to the pages of this work.]

A.

ACETONE. A peculiar, volatile, inflammable liquid; obtained by distilling the anhydrous acetates; is frequently confounded in prescriptions with *Wood Spirit* (189).

ACID. The electro-negative element of a compound, containing more than two elements. Acids, when soluble, have generally a sour taste and redden vegetable blues. They may be either Oxyacids, Hydracids, or Sulphur Acids (q. v.).

ACTINISM. A term employed to designate the chemical effects of light.

ÆELOPILE. An instrument for producing a blast by means of the vapour of a liquid heated in a close vessel.

ÆRUGO. Verdigris (156).

ÆTHIOP'S MINERAL. Protosulphide of Mercury (166).

AEREOMETER. An instrument for the determination of specific gravities.

AFFINITY. The tendency of bodies to combine (15).

AMPHIDE Salt. A salt consisting of a union of an Acid of Oxygen, Sulphur, Selenium, or Tellurium, with a base of the same elements (66).

AMPHIGEN. Synonymous with Basacigen.

ALEMBIC. A still, with a cap, from which proceeds a tube, used in SUBLIMATION.

ALKALIMETRY. The process for determining the quantity of Alkali in a given solution.

ALKALOID. A term applied to the Vegetable Alkalies, as Quinia.

ALKARSIN. Oxide of Kakodyl (200).

ALLOTROPISM. A term used to designate the different conditions or states, in which the same elementary body may occur (55).

ALLOY. The combination of two metals.

AMALGAM. The union of Mercury with a metal.

ANALYSIS. The determination of the constituents of a compound. It may be *qualitative*, which determines their nature, or *quantitative*, which fixes their amount.

ANHYDROUS. Free from Water.

ANTIMONIAL WINE. A solution of Tartar Emetic in Sherry Wine (148).

AQUA FORTIS. Impure Nitric Acid (44).

AQUA REGIA. Nitromuriatic Acid (69).

ANODE. The positive pole of a galvanic battery (Zincoid).

ARGILLACEOUS.—Containing Clay.

ARGOL. Crude Cream of Tartar (88).

ATOM. The ultimate particle of an element or compound.

ATOMIC NUMBER. The specific gravity of a substance divided by its equivalent.

ATOMIC VOLUME. The equivalent of a substance, divided by its specific gravity.

ATOMIC WEIGHT. Equivalent (16).

AUSTRAL. The Southern Polarity of a magnet (27).

AZOTE. Nitrogen.

AZOTIC ACID. Nitric Acid (44).

B.

BARILLA. The ashes of sea-plants. It contains Carbonate of Soda (91).

BASACIGEN. A term applied to elements, as Oxygen, which, combining with others, form either Acids or Bases.

BASE. A substance capable of combining with acids to form salts.

BASIC. A substance possessing the properties of a base;

also applied to a compound in which the base is in excess (75).

BASYL. Hydrogen, the metals, and the quasi-metals.

BATTERY. An apparatus for the accumulation of electricity (30).

BESTERCHEF'S TINCTURE. An ethereal solution of the Sesquichloride of Iron.

BINARY. A compound of two elements.

BITTERN. The liquid left after the separation of Common Salt from sea-water.

BLACK FLUX. A mixture of Carbon and Carbonate of Potassa. Is made by heating Cream of Tartar in a close vessel.

BLACK LEAD. Plumbago.

BLACK WASH. Is made by adding Calomel to Lime-Water; it contains Protoxide of Mercury.

BLEACHING POWDER. Chlorinated Lime (110).

BLUE MASS. *PILULÆ HYDRARGYRI (163).

BLUE OINTMENT. *UNGENTUM HYDRARGYRI (164).

BLUE VITRIOL. Sulphate of Copper (155).

BONE ASH. Consists principally of Basic Phosphate of Lime, with Lime. Is obtained by calcining bones, by which their animal matter is destroyed (62).

BONE BLACK. Animal Charcoal, obtained by the dry distillation of bones. It contains their earthy constituents (47).

BORAX. Biborate of Soda (97).

BOREAL. The Northern Polarity of a magnet (2).

BRIMSTONE. Roll Sulphur (55).

BRITISH GUM. Dextrine (181).

BURNETT'S DISINFECTING FLUID. Solution of Chloride of Zinc (160).

BUTTER OF ANTIMONY. Chloride of Antimony (148).

BUTTER OF ZINC. Chloride of Zinc (160).

C.

CADET'S LIQUID. Alkarsin (200).

CALAMINE. Impure, native Carbonate of Zinc (159).

CALCINATION. Exposure of substances to a high heat in an open vessel, so that the Oxygen of the air may combine with their oxidizable constituents.

CALOMEL. Protochloride of Mercury (167).

CARAMEL. Burned Sugar (184).

CARBOLIC ACID. Coal-tar Creasote.

CATALYSIS. The action of a body in promoting Combination, or Decomposition, by its presence, the body itself remaining unchanged.

CATHODE. The negative pole of a Galvanic Battery (Chloroid).

CELLULOSE. Lignin (181).

CHALK. An amorphous Carbonate of Lime (109).

CHAMELEON MINERAL. Manganate of Potassa.

CHLOROID. The negative pole, or that connected with the Zinc Plate of a Battery.

CHOKE DAMP. Carbonic Acid.

CHROME YELLOW. Chromate of Lead (134).

CHROME GREEN. A mixture of Chrome Yellow, and Prussian Blue; or Sesquioxide of Chromium (134).

CINNABAR. Bisulphide of Mercury (167).

CITRINE OINTMENT. Ointment of the Nitrate of Mercury (166).

COLCOTHAR. Sesquioxide of Iron.

COLOPHONY. Common Resin, or Rosin.

COMBINING WEIGHT. Equivalent.

COMMON SALT. Chloride of Sodium (95).

COPPERAS. Green Vitriol (127).

CORROSIVE SUBLIMATE. Bichloride of Mercury (169).

CREAM OF TARTAR. Bitartrate of Potassa (88).

CROCUS OF ANTIMONY. Oxysulphide of Antimony.

CROCUS MARTIS. Colcothar.

CUBIC NITRE. Nitrate of Soda.

D.

DECANTATION. Pouring off, or drawing off with a syphon.

DECOCTION. The extraction of vegetable, or animal matter, by boiling; or the solution thus obtained.

DECREPITATION. The crackling of certain Salts, when suddenly heated.

DEFLAGRATION. A rapid and scintillating combustion. Takes place in certain mixtures containing the Nitrates, or Chlorates.

DELIQUESCENT. A term applied to those substances

whose attraction for water is such, that they become moist, or liquid in the air.

DESTRUCTIVE DISTILLATION. Dry distillation.

DETONATION. Rapid chemical action, accompanied by flame and noise.

DEW-POINT. The temperature at which the moisture of the air begins to deposit.

DIGESTION. The soaking of a body, for a long time, in *hot water*.

DIMORPHOUS. A term applied to substances, which crystallize in two distinct and incompatible forms.

DISPLACEMENT. A method of extracting the soluble portions of vegetable or animal matters, by causing the menstruum to filter through a given bulk.

DISTILLATION. The process for separating a liquid from a solid or less volatile liquid, by heating the mixed substances, and collecting the condensed vapour.

DONOVAN'S SOLUTION. The solution of the Iodide of Arsenic and Mercury (171).

DRY DISTILLATION. The process by which solid, or organic bodies, are subjected to heat in a close vessel.

DUCTILE. Capable of being drawn out into wire.

E.

EAU DE JAVELLE. A solution of Chlorinated Potassa, similar in composition to the solution of Chlorinated Soda.

EBULLITION. The bubbling of a boiling liquid.

EFFERVESCENCE. The bubbling from the escape of gas from a liquid.

EFFLORESCENCE. A property peculiar to certain salts, which, exposed to the air, crumble, owing to the loss of a portion of their water of crystallization. The term is also employed to designate the crust formed by the drying of certain salts upon the surface of bodies, in which they are not visible.

ELECTRODE. The pole of a galvanic battery.

ELECTROLYSIS. Voltaic decomposition.

ELEMENT. A simple, undecomposable substance.

ELIXIR OF VITRIOL. Aromatic Sulphuric Acid (59).

ELUTRIATION. A process for separating the grosser portions of an insoluble powder by suspending it in Water, allowing partial subsidence, drawing off the liquid containing the lighter portions, which are then allowed to settle (109).

EPSOM SALT. Sulphate of Magnesia (114).

EQUIVALENT. The proportional numbers, according to which, or their multiples, bodies combine.

EREMACAUSIS. The slow decay of organic substances, not containing Nitrogen (182).

ESSENTIAL OILS. Volatile Oils.

EUDIOMETER. An instrument for ascertaining the amount of Oxygen in a gaseous body, by introducing an excess of Hydrogen, exploding the mixture, and noting the diminution of volume.

EVAPORATION. Conversion into vapour, without ebullition.

F.

FERMENTATION. Decomposition by example (86).

FILTER. A porous substance, used to separate a solid and liquid, by allowing the latter to pass through, while the former is retained.

FIRE DAMP. Light Carbonetted Hydrogen (Marsh Gas) (54).

FLUOR SPAR. Fluoride of Calcium (74).

FOWLER'S SOLUTION. Solution of the Arsenite of Potassa (144).

FLOWERS OF SULPHUR. Sublimed Sulphur (55).

FLOWERS OF ZINC. Oxide of Zinc (157).

FLOWERS OF ANTIMONY. Oxide of Antimony (145).

FLOWERS OF BENZOIN. Benzoic Acid.

FUSEL OIL. Amylic Alcohol (189).

FUSION. The passage of a solid into the liquid state by heat.

FUSIBLE CALCULUS. Phosphate of Lime, with Phosphate of Magnesia and Ammonia.

G.

GALENA. Native Sulphide of Lead.

GAS. An elastic fluid.

GLASS. An union of Silicic Acid with a base : generally an Alkali, Earth, or the Oxides of Lead and Iron.

GLASS OF ANTIMONY. Roasted and fused Tersulphide of Antimony.

GLASS OF BORAX. Fused Borax.

GLAUBER'S SALT. Sulphate of Soda (93).

GLUCOSE. Grape Sugar (185).

GLYCOCOLL. Sugar of Gelatine.

GOLDEN SULPHUR. Pentasulphide of Antimony, SbS_5 .
Is a Sulphur Acid (145)

GORNIOMETER. An instrument for measuring the angles of crystals.

GOULARD'S EXTRACT. Solution of the Subacetate of Lead (153).

GOULARD'S CERATE. Cerate of the Subacetate of Lead (154).

GRAPHITE. Plumbago (46).

GREEN VITRIOL. Sulphate of the Protoxide of Iron (Protosulphate of Iron) (127).

GYPSUM. Sulphate of Lime (111).

H.

HALOGEN. An element capable of combining directly with a metal to form a salt (65).

HALOID Salt. A Binary compound, formed by the union of an Halogen with a metal (65).

HARTSHORN. Ammonia (101).

HEPAR SULPHURIS. Liver of Sulphur (83).

HOFFMAN'S ANODYNE. Compound Spirit of Aether (192).

HOMOLOGOUS. A term applied to a series of analogous substances, whose composition varies by C_2H_2 , or a multiple of it (Gerhart).

HYDRACID. Hydrogen-Acid. An acid, consisting of a salt radical united with Hydrogen (66).

HYDRATE. A combination of Water with an acid or a base.

HYDRIODATE. A salt of Hydriodic Acid. Is an incorrect term; *Iodide* of the metal should be used.

HYDROMETER. An instrument for the determination of the specific gravities of liquids.

HYGROMETER. An instrument for the determination of the relative amount of moisture in the air.

I.

IMPONDERABLE. Without weight; employed to designate Light, Heat, Electricity, and Magnetism.

INCANDESCENCE. The glow of a highly heated body.

INCINERATION. The reduction of a substance to ashes.

INCOMPATIBLE. Incapable of being mixed without chemical change.

INFUSION. Steeping a body in hot or cold water for a short time, or the solution thus obtained.

INOSITE. Sugar of flesh.

ION. A body going to the positive (anode) or negative (cathode) pole of a galvanic battery, during electrolysis.

IODIC ÆTHER. Iodide of Æthyl.

IRON PYRITES. Native Sulphide of Iron.

ISOMERIC. Substances having the same composition, with different properties.

ISOMORPHOUS. Substances having the same crystalline form.

ISINGLASS. Gelatine.

IVORY BLACK. Animal Charcoal, made by distilling Ivory scraps; is generally applied to Bone Black (47).

J.

JAMES'S POWDER. *Pulvis Antimonialis* (149).

K.

KERMES' MINERAL. A variable mixture of Tersulphide and Oxysulphide of Antimony, with Sulphide of Potassium (146).

KELP. Ashes of sea-weeds; used as a source of Iodine (70).

L.

LABARRAQUE'S Disinfecting Liquid. Solution of Chlorinated Soda (96).

LAC SULPHURIS. Milk of Sulphur (56).

LACTIN. Sugar of Milk.

LAMPBLACK. Finely divided Carbon, obtained from the smoke of Tar, &c.

LAPIS INFERNALIS. Lunar Caustic (174).

LAUGHING GAS. Protoxide of Nitrogen (43).

LEAD WATER. Diluted Goulard's Extract (154).

LEDOYEN'S Disinfecting Liquid. Solution of Nitrate of Lead (151).

LEVIGATION. The reduction of a substance to an impalpable powder, by rubbing on a slab, with a flat pestle, called a muller (109).

LIMESTONE. A Carbonate of Lime.

LIQUEFACTION. The conversion of a solid into liquid; also applied to the conversion of a vapour into a liquid.

LITHARGE. Semivitrified Oxide of Lead (150).

LITHIC ACID. Uric Acid.

LIVER OF SULPHUR. Sulphide of Potassium (83).

LIXIVIATION. The separation of the soluble portions of a substance, by causing water to filter through it.

LOADSTONE. The native magnetic Oxide of Iron.

LUGOL'S SOLUTION. Compound Solution of Iodine (72).

LUNAR CAUSTIC. Nitrate of Silver (174).

LUTE. Adhesive mixtures for closing the joints of apparatus, to prevent the escape of vapours, &c.

M.

MACERATION. The long-continued soaking of a substance in water, at common temperatures.

MAGMA. A molasses-like mass (139).

MAGNESIA ALBA. Carbonate of Magnesia (113).

MALLEABLE. Capable of being beaten out into leaves.

MARBLE. Crystallized Carbonate of Lime.

MASSICOT. Protoxide of Lead (149).

MATRASS. A glass vessel, with a long neck, used for digestion.

MENSTRUUM. The liquid employed to dissolve substances.

MERCAPTAN. Alcohol, in which all the Oxygen is replaced by Sulphur ($C_4H_6S_2$).

MICROCOSMIC SALT. Phosphate of Soda and Ammonia.

MILK OF SULPHUR. Precipitated Sulphur (56).

MINERAL WATER. Water charged with Carbonic Acid; also, natural waters holding medicinal substances in solution (50).

MINIUM. Red Oxide of Lead (149).

MOLECULES. The elementary, or compound atoms of bodies.

MULBERRY Calculus. Oxalate of Lime.

MURIATIC Acid. Hydrochloric (68).

MURIATE. The compound of Muriatic Acid with a

base. Properly the *Chloride* of the metal of the base (66).

MURIATED TINCTURE of Iron. Tincture of the Sesquichloride (129.)

N.

NAPHTHA. A natural, oily Carbohydrogen, $C_{14}H_{15}$.

NASCENT. Recently liberated from combination.

NEUTRAL. 1. Possessing neither Acid nor Alkaline reaction. 2. Having no tendency to combine with acids or bases. 3. Applied to Salts, where the number of equivalents of the Acid is equal to those of the Oxygen in the base.

NEUTRAL MIXTURE. Solution of Citrate of Potassa (82).

NITRE. Saltpetre (80).

O.

OIL OF VITRIOL. Hydrated Sulphuric Acid (58).

ORPIMENT. Yellow Sulphide of Arsenic, AsS_3 .

OXYACIDS. Oxygen Acids; acids, whose electro-negative constituent is Oxygen.

OXYCHLORIDE. The combination of the Chloride and Oxide of a metal.

OXYSLALT. The union of an Oxygen Acid with a base containing Oxygen.

OXY SULPHIDE. The combination of the Oxide and Sulphide of a metal.

P.

PARTICLE. Atom.

PEARL ASH. Impure Carbonate of Potassa (81).

PEARL POWDER. Subnitrate of Bismuth (136).

PHOTOGRAPHY. The art of taking pictures by light.

PICRIC ACID. Carbazotic Acid.

PLASTER of Paris. Sulphate of Lime (111).

PLATINUM, BLACK and SPONGE. Finely divided Platinum (176).

PLUMBAGO. Carbon (46).

POTASH. Impure Carbonate of Potassa.

POWDER OF ALGAROTH. Oxychloride of Antimony (147).

PRUSSIC ACID. Hydrocyanic Acid (51).

PRUSSIAN BLUE. Ferrocyanide of Iron (133).

PSEUDOMORPH. A mineral body, crystallized in the form that belongs to another mineral.

PUTTY POWDER. Stannic Acid (135).

PURGATIVE MINERAL WATER. Solution of Citrate of Magnesia (114).

PYRO. A prefix, to distinguish a body, altered by heat, from the one from which it is derived.

PYROPHOROUS. A powder, capable of igniting spontaneously in the air.

PYROXILIC SPIRIT. Wood Alcohol (197).

PYROXYLINE. Gun-cotton (181).

PYRITES. Sulphide of Iron, or Copper.

Q.

QUATERNARY. The union of two ternary compounds.

QUEVENNE'S IRON. Powder of Iron (121).

QUICKLIME. Caustic Lime.

QUICKSILVER. Mercury.

R.

REAGENT. An agent employed as a chemical test, or in chemical operations.

REALGAR. Red Sulphide of Arsenic, AsS_2 .

RED PRECIPITATE. Binoxide of Mercury (165).

RED PRUSSIATE OF POTASH. Ferricyanide of Potassium (204).

REGULUS OF ANTIMONY. Metallic Antimony.

ROCHELLE SALT. Tartrate of Potassa and Soda (98).

ROUGE. Sesquioxide of Iron.

RUST. Oxide of Iron; generally Hydrated Sesquioxide.

S.

SACCHARUM SATURNI. Sugar of Lead.

SAL ACETOSELLA. Binoxalate of Potassa.

SAL AERATUS. Bicarbonate of Potassa (82).

SAL AMMONIAC. Chloride of Ammonium.

SAL ALEMBROTH. Double Chloride of Mercury and Ammonium (103).

SAL DIURETICUS. Acetate of Potassa (87).

SAL ENIXUM. Bisulphate of Potassa.

SAL MIRABILE. Sulphate of Soda (93).

SAL PERLATUM. Phosphate of Soda (94).

SAL PRUNELLE. Fused Nitre (80).

SALOGENS. Salt radicals.

SALT. The union of an acid with a base, or of a halogen with a metal.

SALT RADICALS. The electro-negative group: Oxygen, Sulphur, the Halogens.

SALT OF LEMONS. Binoxalate of Potassa.

SALT OF SORREL. Binoxalate of Potassa.

SALT OF TARTAR. Pure Carbonate of Potassa (82).

SALTPETRE. Nitrate of Potassa (80).

SATURATION. 1. The solution of a body in a liquid, until it refuses to dissolve more; 2. The neutralization of a base by an acid, or of an acid by a base.

SCHEELE'S GREEN. Arsenite of Copper.

SEIDLITZ POWDERS. Contain Rochelle Salt (98).

SEIGNETTE'S Salt. Rochelle Salt (98).

SODA ASH. Crude Carbonate of Soda (92).

SODA SALTPETRE. Nitrate of Soda.

SOLUBLE TARTAR. Neutral Tartrate of Potassa (88).

SOLUTION. The union of a solid, liquid, or gas, with a liquid, in which it disappears or becomes liquid.

SPELTER. Zinc.

SPIRIT OF HARTSHORN. Spirit of Ammonia (101).

SPIRIT OF MINDERERUS. Solution of Acetate of Ammonia (104).

SPIRIT OF NITRE. Spirit of Nitric Æther (193).

SPIRIT OF SALT. Muriatic Acid.

SPIRIT OF WINE. Alcohol (193).

SUBLIMATION. The process of separating a volatile solid from one more fixed, by the application of heat.
The condensed body is called a SUBLIMATE.

SUBSTITUTION. The replacement of an element or compound by another.

SUGAR OF LEAD. Acetate of Lead.

SULPHURET. Sulphide (153).

SULPHURETTED HYDROGEN. Hydrosulphuric Acid (60).

SULPHURIC ÆTHER. Æther (190).

SULPHUR ACID. An acid in which Sulphur is the electro-negative element.

SULPHUR BASE. A Sulphide capable of combining with a Sulphur Acid.

SULPHUR SALT. The union of a Sulphur Acid and Sulphur Base.

SULPHUR LOTUM. Washed Sulphur (56).

SULPHUR VIVUM. Impure Sulphur, *Horse Brimstone*.

SUPERCARBONATE. Bicarbonate.

T.

TANNIN. Tannic Acid.

TARTAR EMETIC. Tartrate of Antimony and Potassa (147).

TASTELESS PURGING SALT. Phosphate of Soda (94).

TERNARY. The union of two binary compounds.

TINCTURE. A solution in Alcohol. When in \mathcal{A} ether, is called an *Aethereal Tincture*.

TRITURATION. Rubbing in a mortar.

TURNBULL'S BLUE. Ferricyanide of Iron, Fe_3Cfdy (204).

TURNER'S CERATE. Calamine Cerate (159).

TURPETH MINERAL. Yellow Sulphate of Mercury (167).

TUTTY. Impure Oxide of Zinc.

W.

WHITING. Prepared Chalk.

WHITE ARSENIC. Arsenious Acid (138).

WHITE LEAD. Carbonate of Lead (151).

WHITE PRECIPITATE. Chloramide of Mercury (172).

WHITE VITRIOL. Sulphate of Zinc (160).

WOOD NAPHTHA. Wood Spirit (197).

WOOD SPIRIT. Methyl Alcohol (197).

Y.

YELLOW PRUSSIATE OF POTASH. Ferrocyanide of Potassium (89).

YELLOW WASH. Made by adding Corrosive Sublimate to Lime Water; Hydrated Binoxide of Mercury is formed (165).

Z.

ZINCOID. The positive pole of a battery; that connected with the Copper or Platinum plate.

ZINC WHITE. Oxide of Zinc (158).

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